

The Auk

A Quarterly Journal of Ornithology

Vol. 77

JULY, 1960

No. 3



PUBLISHED BY

The American Ornithologists' Union

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Printed by The Intelligencer Printing Company
Lancaster, Pa.

Entered as second-class matter in the Post Office at Lancaster, Pa.,
May 15, 1920, under the Act of August 24, 1912

Accepted for mailing at special rate of postage provided for in the Act of October 3, 1917,
embodied in paragraph (d)-(2) of Section 34.40, P. L. and R., of 1948, authorized May 15, 1920.

THE AUK
A QUARTERLY JOURNAL OF
ORNITHOLOGY

VOL. 77

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COURTSHIP AND TERRITORIAL BEHAVIOR
OF HAIRY WOODPECKERS

LAWRENCE KILHAM

THE present study of a pair of Hairy Woodpeckers (*Dendrocopos villosus*), made in a swamp near Seneca, Maryland, indicates that this species has a lively courtship in which the female may attract a mate to her fall and winter territory by drumming and then join him in display flights. I observed this behavior in the pair HF-HM from mid-October 1958, until nest excavation in April 1959, in all a total of 130 hours. The phenomena described are not readily observable in any one year, and I have encountered the prolonged type of pair formation in only one of the years from 1951 to 1960 in which I have been studying Hairy Woodpeckers in the same swamp. These birds appear to be more or less paired the year around under usual circumstances. Hairy Woodpeckers are not easy to study in wooded country, and this may explain why published accounts of their life histories, such as those of Bent (1939), are far from complete. Hailman (1959), for example, has pointed out that the drumming of female Hairy Woodpeckers is not mentioned in most accounts. As described below, the female HF did an extraordinary amount of drumming.

Individual recognition of the woodpeckers studied became possible with close and prolonged observation. Figure 1 gives the head markings by which I distinguished HF and HM as well as of two other Hairy Woodpeckers with which they had occasional contacts. Certain features of habit and territory, given below, further aided in the recognition of individual birds.

TERRAIN AND TERRITORY

Territory and drum trees. Observations were centralized in the terri-



Figure 1. Variations in the black and white markings on the heads of four Hairy Woodpeckers, which aided in recognition of individuals. The male HM and the female HF are represented by the two central figures.

tory of the female HF, where most of the courtship and the later nest excavation took place. The terrain consisted of a rim of trees surrounding three to four acres of open swamp. Since the open area was dry during the fall and was frozen during much of the winter, I was able to walk about the center of HF's territory and adequately view her activities. There were several indications that the territory of HF had fairly definite boundaries. One was that she continually made rounds of certain drumming trees, of which three were visited on many occasions and five others with less frequency. She would alight at particular spots where she could obtain the greatest reverberation. The farthest distance between regular drum trees was 450 yards (Figure 2). The width of HF's territory was in the vicinity of 250 yards, as estimated by the locations of conflicts and distances between two of the main drumming trees. The male HM had an adjacent territory, approximately 400 yards long, but I had less complete observations on its dimensions since most of the activities concerned with pair formation took place in the territory of his mate.

Territory and conflicts. A second circumstance that served to establish the boundaries of HF's territory consisted of seven conflicts with intruding Hairy Woodpeckers that I observed in boundary zones (Figure 2) in the course of nine months. Five of these conflicts were between females, and two were between rival males. There was a tendency for conflicts to be repeated in the same zones, for two of the female conflicts were in one zone and two took place in another. Conflicts in a third zone were of a different pattern. On 14 March HM fought another male, and on 21 March 1959, his mate HF fought a rival female along the same boundary, which was not far removed from the tree where HF excavated a nest hole in late April.

Nest sites of three different years bunched. The territory of HF

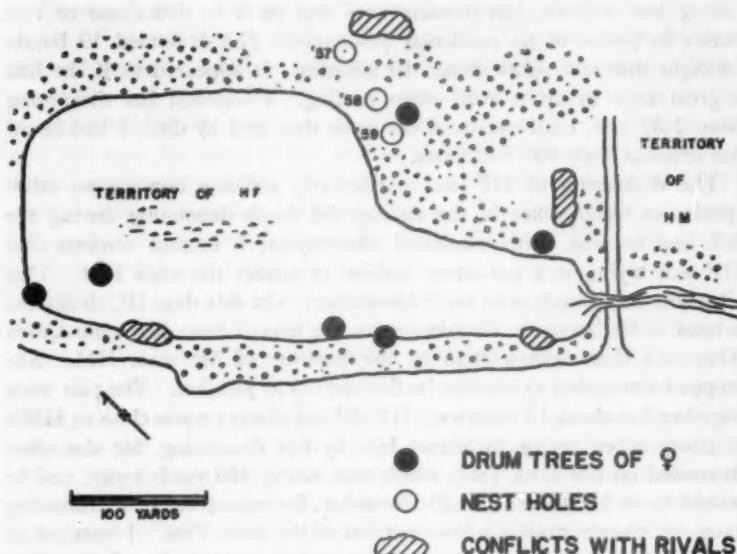


Figure 2. Diagram of the fall and winter territory of the female Hairy Woodpecker HF, showing the locations of her main drum trees, the zones of boundary conflicts, and the nest sites of three successive years.

was not only the site of nest excavation in 1959, but also of nest holes where I had observed parent Hairy Woodpeckers feeding their young in 1957 and 1958 (Figure 2). The three nest holes were within a distance of 100 feet.

PAIR FORMATION IN FALL AND WINTER

Drumming. I heard drumming from HF's main drum tree during September and October 1958, but it was 18 October before the swamp became dry enough for me to start consistent observations. The female HF drummed hundreds of times on favorable days. Such a day was 8 November. HF began drumming at 7:45 A.M., when the swamp was covered with frost and skim ice. She drummed 54 times in five minutes on what I called her China Tree because it had a reverberation and tone, due to its hardness, which I could recognize at 800 yards. Her drumming rate of 11 bursts a minute represented an intense level of behavior. This intensity was also reflected in another type of drumming. At about 8 A.M., on the same morning, I found HF feeding

among low willows, but pausing here and there to drum one or two bursts in places of no particular resonance. She drummed 19 bursts on eight different spots within 10 minutes. It appeared as if she had a great urge to drum even when feeding. I watched her drumming from 2:35 P.M. until sunset of the same day, and by dusk I had heard her drum at least 400–500 times.

The drumming of HF was particularly striking because no other species of woodpecker in the swamp did much drumming during the fall, and because, with continued observation, it became obvious that HF was trying in a persistent fashion to attract the male HM. This situation was clearly seen on 9 November. On this day, HF drummed a total of 98 bursts in 20 minutes as she moved from her main China Tree to a dead willow close by the territory of her mate HM. She stopped drumming as soon as he flew across to join her. The pair were together for about 15 minutes. HF did not always come close to HM's territory when trying to attract him by her drumming, for she often drummed on her Low Tree, which was nearly 450 yards away, and he would fly to her there. On 26 December, for example, HF's drumming rang out clearly from a hollow portion of the Low Tree. I watched as she flew to the top of an adjacent tree as if expectant, then flew to join HM in the top of a dead elm right above where I stood. Such meetings were always of much the same form. The two birds above me rested within about five inches of each other without display of any kind and exchanged a rapid *jeek, jeek* vocalization.

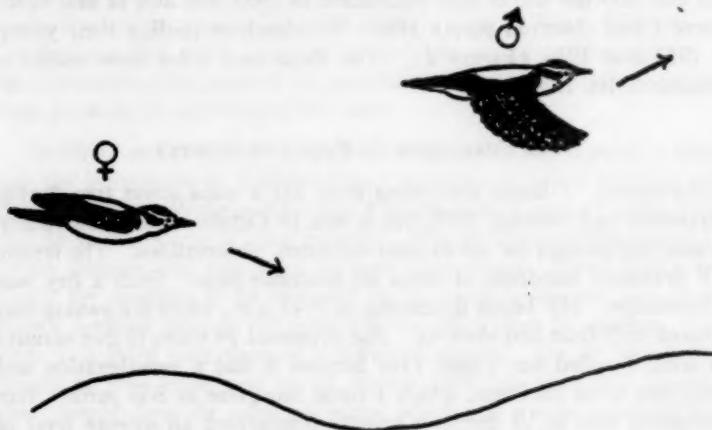


Figure 3. Duet flight of the pair of Hairy Woodpeckers HF-HM, which took place above the treetops, usually over the territory of HF.

Display flights. HF and HM usually launched themselves off on a display flight after their *jeek, jeek* greetings. I termed these performances duet flights. When standing in the center of the swamp, I could watch the two Hairy Woodpeckers, one rising and one falling as they swung great bounds and loops above the treetops of HF's territory, now one and now the other in the lead as if without apparent aim. These flights were not pursuits; HF and HM would alight peacefully, fairly close together, in pauses between flights. The duet flights centered, primarily, over the woods where the 1957, 1958, and 1959 nest excavations were all located (Figure 2).

HF performed a second type of display. I termed it the Floating Flight, and I had views of HF in these flights on six occasions between 1 November and 28 December 1958. A floating flight on 8 November was of special interest. HF had done much drumming, as described above, and had participated in many duet flights with her mate. At sunset, which was about 4:30 P.M., I was standing in the open swamp when HF, flying toward me in bounding flight, suddenly broke into a batlike flutter with alternations of floating with wings held motionless, at an angle of 45 degrees. She made *tweeck, tweeck* notes at the same time. I have not heard these notes from a Hairy Woodpecker on any other occasion. HF alit on a dead oak, drummed five or six bursts,



Figure 4. The female Hairy Woodpecker HF in a floating display flight.

then went off on a long flight up swamp, as I presumed, to roost for the night. These floating flights of HF always took place when she was flying to or away from a meeting with her mate. If male Hairy Woodpeckers have a similar display flight, I have not observed it.

Tapping. The tapping of the Hairy Woodpeckers came as a surprise, for it was done under different circumstances than those that I (1958) had observed for Red-bellied Woodpeckers (*Centurus carolinus*). The tapping of both species is at a countable rate of two to three taps a second. HF had drummed almost incessantly during the morning of 22 November when, at 11:30 A.M., she alighted on a small tree 30 feet from me. She now tapped 9 or 10 times, loud and clearly, paused, then tapped eight more series for a total of about 80 taps. I heard HF tap on four occasions between 9 November and 7 December. None of this tapping was associated with any obvious nest hole, but on 1 February 1959, I saw HM fly to a fresh excavation and tap three bursts just below it. I believed that HF was nearby for I heard *jeeks*. The excavation belonged to a pair of Red-bellied Woodpeckers, which nested in it the following May.

Conflicts. HF was facing a rival female at one of her territorial boundaries in each of the five conflicts that I observed between November 1958 and March 1959. A conflict on 17 January was representative. HF alit on a tree trunk above the intruder, pointing her bill upward and almost backward as she did a bill-waving dance, which involved jerking of her head and body as well as half-starting motions with her wings. Her rival posed as if frozen with her bill pointed straight forward. HF dropped to a lower position, then pursued her adversary up the trunk. Such dance displays are carried out by both sexes, but all conflicts I have observed have been between Hairy Woodpeckers of the same sex. Conflicts are silent affairs if only two woodpeckers are engaged. If a third bird, a mate of one of the participants, is nearby, one may hear vocalizations such as *chewi, chewi* or *jeek, jeek*. I heard both of these notes on 17 January. Skutch (1955) has given a good description of two male Hairy Woodpeckers dancing in conflict.

ACTIVITIES OF THE MALE

A lane, which served as a boundary between the territories of HF and HM (Figure 2), afforded me a wide view of the exchanges of visits between these two woodpeckers. The female HF made only occasional visits to HM's territory. I would hear an exchange of *jeeks*, but I never saw her drum nor did I witness any duet flights on his side of the lane. HM visited his mate's territory far more frequently, in response to her persistent drumming. He, however, sometimes took the initiative. I heard him begin to drum on a number of mornings during the fall and winter at times when HF was silent. He would move to drum trees successively nearer to her territory, and on 7

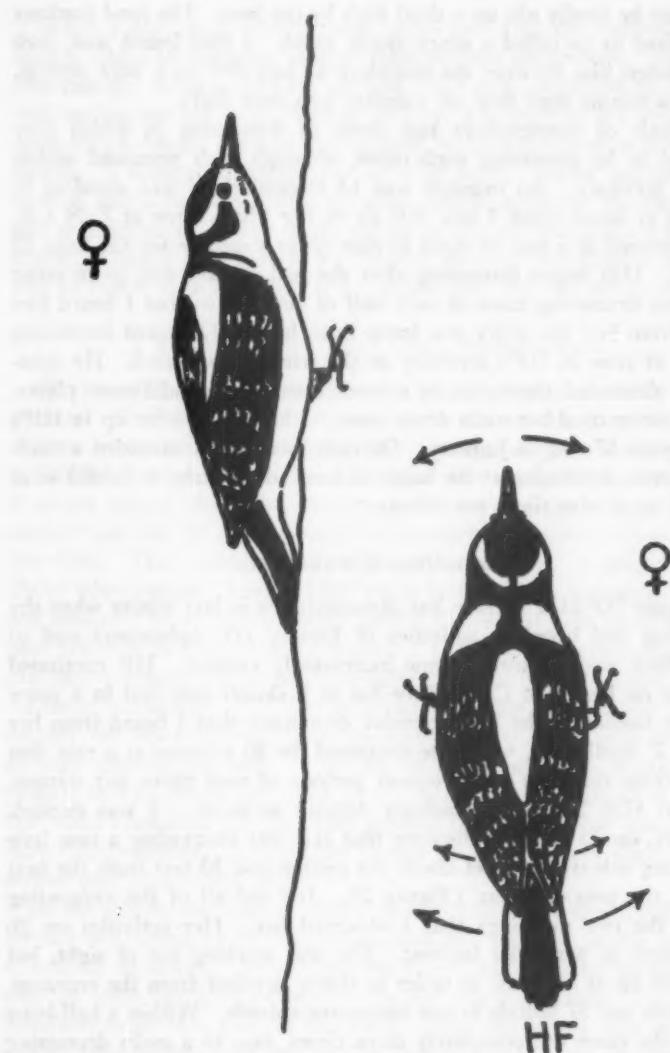


Figure 5. A conflict between two female Hairy Woodpeckers along the territorial boundary of HF. The owning female HF threatens by jerking her body about and waving her bill while the intruder (upper figure) has temporarily assumed a frozen pose.

December he finally alit on a dead limb by the lane. His head feathers were raised as he called a sharp *speck, speck*. I then heard *jeek, jeek* and watched him fly over the boundary to join HF on a bare treetop. Within a minute they flew off together in a duet flight.

The pair of woodpeckers had duets of drumming in which they appeared to be answering each other, although each remained within its own territory. An example was 13 December. I was standing in the lane at dawn when I saw HF fly to her China Tree at 7:28 A.M. She drummed at a rate of eight to nine times a minute for the next 22 minutes. HM began drumming after she had started, and, as in other duets, his drumming came at only half of her rate so that I heard two bursts from HF for every one burst from him. HM spent increasing periods of time in HF's territory as the winter progressed. He occasionally drummed there, but in a weak manner, on indifferent places, and he never used her main drum trees. I located him far up in HF's territory on 17 and 18 January. On each morning he ascended a number of trees, drumming at the bases of small, dead limbs as he did so at rates of up to nine times per minute.

NEST-HOLE EXCAVATION

The pair HF-HM became less demonstrative in late winter when the drumming and breeding activities of Downy (*D. pubescens*) and of Red-bellied woodpeckers became increasingly evident. HF continued to drum on her main China Tree but at a slower rate and in a more sporadic fashion. The last extensive drumming that I heard from her was on 7 April 1959, when she drummed for 40 minutes at a rate that varied from three up to infrequent periods of nine times per minute. HF and HM became increasingly difficult to locate. I was excited, therefore, on 25 April to discover that HF was excavating a nest hole in a living ash tree, 40 feet above the swamp and 50 feet from the nest hole of the previous year (Figure 2). HF did all of the excavating during the two mornings that I observed her. Her activities on 26 April were of particular interest. She was working out of sight, but she came up at intervals in order to throw sawdust from the entrance. She threw out 37 billfuls in one successive episode. Within a half-hour period she came out completely three times, flew to a main drumming tree nearby, and drummed briefly. It appeared that she wanted HM to visit her. When he arrived, which was usually within a few minutes, he might visit the excavation for a brief look, fly to her at the drum tree, and exchange a variety of notes ranging from *jeek* to *joick* and *chewi*. HM would then fly away, leaving his mate to excavate alone.

When a pair of Bluebirds came by to look into the excavation, the female Hairy Woodpecker flew at them without excitement. The situation changed when a Starling arrived. HF now displayed by uptilting and waving her bill while jerking her body and starting her wings; the same threat display she had used against territorial intruders of her own species. I never encountered HF after 26 April. There was never any sign of actual nesting during the next month, although the excavation was completed so far as I could tell by having my son explore it with a probe. I found HM back in his original territory but without evidence that he had a mate in May. It is possible that HF had been killed.

COMPARISONS WITH OTHER WOODPECKERS

The above observations were made on a single pair of Hairy Woodpeckers. Considering the wide territories covered by these birds, the shyness of the females, the difficulties of recognizing the sex unless the individual woodpecker has its back to the observer and is not too active, it would appear that a satisfactory life history of *D. villosus* may be worked out only by concentration on favorable situations such as I have described. The findings were not altogether unique. A second pair of Hairy Woodpeckers, located 1,000 yards farther down in Seneca Swamp and observed from 23 November until 6 December 1958, paralleled the pair HF-HM in the following respects: (1) The female was extremely shy and restless, taking long, bounding flights from one end of her territory to another. (2) She drummed at a fast rate of 8-11 times a minute, and she drummed more frequently than her mate who drummed at only one-half her rate. (3) The male was not only easier to approach, but his sharp call *speck, speck* made him less difficult to locate. His mate resembled HF in never making this vocalization under ordinary circumstances. Inaccessible terrain made a detailed study of this second pair nearly impossible.

In his studies on banded Hairy Woodpeckers, Shelley (1933) described two instances where females took the initiative in the selection of nesting territories. In one case the female also selected the nest site, and her mate rarely came near while she was excavating. He might, however, come to a tree 40 feet away where she would join him. "I should explain that with this species each sex has a separate territory, that of the male being close to but separate from the female's territory. The male occupies his territory exclusively during the winter. . ." Shelley's note gives little description of methods of communication. It states, however, that when the male and the female of one pair came together in the spring "there was no active mating display." The pair

HF-HM likewise carried on little display at this season. My hypothesis is that Hairy Woodpeckers are more or less mated the year around and that performances associated with initial pair formation are not always observable in any one year in one locality. This may apply also to Pileated Woodpeckers (*Dryocopus pileatus*). In years of observations on this species, I have only once (1959b) encountered an individual actively seeking a mate. This particular woodpecker, a male, did a great deal of drumming within a territory 700 yards long, the length having been determined by the greatest distance between his main drumming trees.

The lead of the female in pair formation, which I have described for *D. villosus*, is also characteristic of some other species of the genus *Dendrocopos*. The Great Spotted Woodpecker (*D. major*) offers a close comparison to *D. villosus* if one considers the following information: (1) Pynnönen (1939) has described a duet flight (*Hintereinand-her-Jagen*) and a floating flight (*Schwebeflug*) in the courtship of this European species. Both sexes have red under tail coverts that are displayed in the *Schwebeflug*. Blume (1958a) has made an illustrative sketch of this performance. His term *flatternd-schwebenden Flugweise* is especially descriptive of the floating flight that I observed for *D. villosus*. (2) In further observations Blume (personal communication) found that two ringed females of *D. major* remained on their breeding territories the year around whereas the males changed. The drumming territories of this species are 400–500 meters long. (3) Blume (1958b) has also described the tapping and drumming of the Great Spotted Woodpecker. The circumstances attending the tapping parallel those found for *D. villosus*.

The Downy Woodpecker is, in my experience, the most difficult of eastern woodpeckers to study. Its activities take place with surprising quickness, and sex recognition, if one wants to make it in a matter of seconds, is not always possible. Shelley, however, as quoted by Bent (1939), stated that "the female selects the nest site on her winter or year-around territory."

In conclusion, it would appear that at least two patterns of early breeding behavior are recognizable among woodpeckers. In one of these, as represented by *Centurus carolinus* (Kilham, 1958) and *Melanerpes erythrocephalus* (Kilham, 1959), the male takes the lead in pair formation and tries to attract a mate to a potential nest site by his loud and repeated breeding calls. The attraction of a mate is different in some species of *Dendrocopos*. As illustrated by *D. villosus*, the female may take the lead in pair formation and attract a male to her winter

territory by repeated drumming. Neither the Hairy nor the Downy Woodpecker has a breeding call. A comparative study of the breeding behavior of these latter two species would be of considerable interest.

SUMMARY

1. The courtship and pair formation of a pair of Hairy Woodpeckers, in which the female attracted the male from his territory to hers, were studied from October until the time of nest excavation in the following April.

2. The courtship activities of the female were most intense in November and early December when she might drum 400–500 bursts in a day, at a rate of 10 bursts a minute. Such drumming might go on for 20 minutes at a time. The male might respond by drumming at a rate of four bursts a minute from his territory. Drumming ceased when he flew across to join her.

3. When the pair was in the territory of the female, the two birds usually (a) greeted each other with the vocalization *jeek, jeek*, and (b) rested within a few inches of each other, without display. (c) The pair might then have a duet flight over the treetops of the female's territory. The male often returned to his own territory after about 15 minutes.

4. The female sometimes displayed a floating, fluttering type of flight, accompanied by the vocalization *tweeck, tweeck*, when approaching or leaving a meeting with the male.

5. The female tapped intensively during the late fall. Tapping by the male was observed on only one occasion.

6. The fall-winter territory of the female was approximately 450 yards long, and its boundaries were marked by (a) the round of her drumming trees and (b) the zones of conflict with rival Hairy Woodpeckers at the periphery.

7. Of seven conflicts observed, five were between females and two were between males. All took place at the female's territorial boundaries. Both sexes did a bill-waving, body-jerking dance when in conflict.

8. The male spent increasing amounts of time in the female's territory during the spring. Drummings, vocalizations, and displays were all diminished at this season.

9. The female excavated a nest hole in late April in close proximity to nest holes used by Hairy Woodpeckers in two previous years. She appeared to do all of the excavating.

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THE BIOLOGY OF THE BENGALESE FINCH

ERICA EISNER

THE Bengalese Finch is a domesticated form of the Sharptailed Finch, *Lonchura striata* (Estrildidae), which has been kept in captivity for at least 200 years. The original stock probably came from southeast China and appears to have been domesticated by the Japanese, there being no apparent connection with Bengal (see Eisner, 1957). It is, I believe, a potentially most useful laboratory animal for it is extremely easy to keep, requires comparatively little space, and breeds freely and reliably all the year round. The present account is based on four years' work with the Bengalese in the Department of Zoology and Comparative Anatomy, Oxford, these results being obtained incidentally to a study of parental behavior in this species. I wish to acknowledge my debt to Professor Sir Alister Hardy and Dr. Niko Tinbergen for affording me the opportunity of working in Oxford, to the Nuffield Foundation for the purchase of apparatus and birds, and to Newnham College, Cambridge, and the Ford Foundation for personal grants.

MANAGEMENT

The staple diet of my finches consisted of a mixture of yellow and white millets and canary seed (see Morris, 1955), to which was added a proprietary mineral mixture (containing mainly calcium and phosphorus but also traces of magnesium and other ingredients), cod liver oil, and wheat germ oil. Sluis Universal Food, a diet intended for insectivorous birds, was always available in the cages, but not much of this was eaten except when young birds were being fed. Maggots (blowfly larvae) and lettuce were given occasionally, the latter especially always being taken very eagerly. Fine sand, shell grit, and cuttlefish bone were constantly available, as was water for drinking and bathing.

The Bengalese is highly social, with a minimum of aggressive behavior, and thus many individuals can be kept together in the same cage. My practice was to keep males and females in separate groups from which individuals were taken as required and put into the breeding cages. Each pair was put into a cage measuring 60 cm. wide by 45 cm. high by 30 cm. deep, which was provided with a nest box about 10 cm. cube in one upper corner. In these they bred without difficulty. The nest boxes were backed by sliding glass panels, which permitted

observation of and access to the nest, the birds being remarkably tolerant of disturbance at the nest.

The floor of the cages consisted of a sliding tray that was kept lined with newspaper in order to facilitate cleaning. It was found sufficient to clean the cages about once a week as the droppings of these birds are normally very dry.

The birds were housed in a hut that was kept always at natural day-length, artificial light never being used after dusk. The facilities for temperature control were not fully adequate. During most of the year, the temperature was maintained within the range of 20–24°C; but this temperature was not maintained when the weather was unusually cold in winter, although the room never fell below 15°, while during hot spells in summer the room temperature often rose, up to 30°.

LONGEVITY

As the natural death rate among these birds is low, I have not yet been able to accumulate sufficient information to provide an estimate of longevity. The expectation of life of Bengalese Finches must be at least three or four years once they have survived to maturity. Of the first nestlings hatched in my stock, during April to June 1955, ten reached maturity. Of these, four have died at 23, 29, 51, and 56 months, and one was accidentally killed at 56 months: the remaining five were still alive in June 1960.

PLUMAGE COLOR AND NESTLING MOUTH MARKINGS

The Bengalese Finch is characteristically piebald, although there is a complete range of variation from birds with no pure white feathers (thus resembling the wild type) to all-white birds with no colored feathers. While at first sight the piebald birds appear to be irregularly marked, this is not altogether the case. Birds with few white feathers tend to have them on the forehead and just under the beak and among the primaries. As their number increases, the white feathers tend to be distributed on the top of the head, down from under the beak onto the breast, on the belly and flanks and in the wings and tail, and there is often a little collar of white feathers across the back of the neck. There is a strong tendency for colored feathers to persist as eye-stripes, in a band across the lower breast (at the level where in the wild type the dark-brown breast feathers and the paler belly feathers meet) and another band ventrally behind the legs, and on the back, even in birds that are predominantly white. In addition to the variations in piedness,

there are factors affecting the pigment, where it occurs: the color may be either the wild-type dark brown or a rich fawn, fawn being recessive to brown, and it is also reported by aviculturalists that the intensity of the color may vary.

A characteristic feature of the estrildines is the occurrence of mouth markings in the nestlings. As this has been considered a most important taxonomic character (cf. Delacour, 1943; Wolters, 1957), it was interesting to find that the mouth markings are not stable in the Bengalese, but are disrupted in association with the disruption of the plumage color. The fundamental pattern in *L. striata* is illustrated in Figure 1, the clearest feature being the single horseshoe mark on the palate. Unfortunately, I did not make accurate drawings for the pur-



Figure 1. The mouth markings of *Lonchura striata*. This was drawn from a two-week-old "self colored" or wild-type Bengalese chick. The thickened edges of the gape corners are bright white, accentuated by the neighboring black skin. The ground color of the palate is bright yellow, making a strong contrast with the black markings. There is a horseshoe-shaped ridge running between the horseshoe and the pair of smaller marks below.

pose of providing an account of the variation in the markings. Only rough sketches were made of the markings at hatching of the chicks, for the purpose of recognizing the chicks individually; later, when the chicks' wing feathers grew (these are the first feathers to emerge, on about day 8 or 9), the distribution of white feathers among them was used for individual recognition. It has therefore been possible to compare my sketches of the mouth markings with the wing index of each chick, and this has confirmed my observation that it is possible to pre-

dict roughly from the mouth markings the future degree of piedness of the bird. For this purpose, I have classified the chicks into six groups according to the degree of disruption of the horseshoe mark at hatching, as follows (see Figure 2) :

1. Horseshoe complete and unbroken.
2. Horseshoe almost complete, a break being evident but the gap so small as not to appear as a distinct space: in these cases the gap usually disappeared altogether within a few days, leaving a complete horseshoe.
3. Horseshoe with one to three definite small gaps, the most frequent form of this being a symmetrical pattern with a central break and one on either side giving two dots at the peak of the horseshoe, the gaps being less broad than the dots. This and the subsequent patterns did not change appreciably as the chicks aged.
4. Horseshoe broken into sections by larger gaps than in (3).
5. Horseshoe represented only by a small stroke at each end, the center being entirely unmarked.

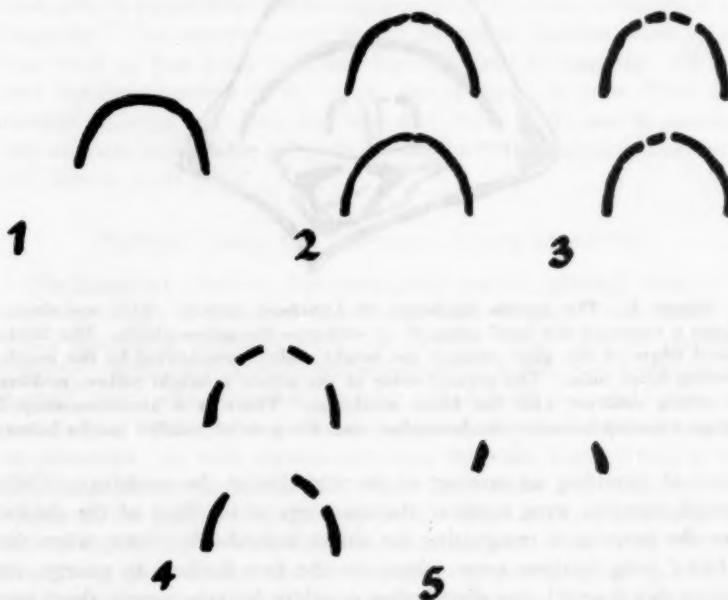


Figure 2. Indications of the way in which the variations of the horseshoe mouth mark were classified, and showing the types of disrupted patterns that occur.

6. Horseshoe completely absent.

Of course, the distinction between these groups was somewhat arbitrary, but most cases did fall clearly into one or the other. The wing indices that I recorded were the number of white feathers among the 9 primaries and 8 secondaries of each wing of the chick. I therefore averaged the number of white feathers among the primaries and secondaries (per wing) for each of the above six groups. The relationship existing between the mouth markings and the plumage is apparent from Table 1.

TABLE 1

Mouth markings Group	Average number of primaries	Average number of white feathers in secondaries	Number of chicks
1	1.4	0.3	6
2	4.2	2.0	23
3	5.4	2.4	28
4	7.3	3.1	22
5	8.3	5.1	27
6	8.6	6.3	22

The birds in Group 1 would be classed as "self-colored" or wild-type birds, showing an almost negligible number of white feathers. Those of Group 6 in my stock did not approach the pure white form but had a substantial amount of colored plumage. Had I had a stock selected for whiteness, the number of white feathers in the wings for Group 6 would have been higher.

In addition to the connection of the disruption of the mouth markings with that of the plumage, the recessive fawn can also be distinguished in newly hatched chicks, for the pigment of the mouth markings and also of the eyeballs is fawn instead of near-black in such birds.

SEXING, MATURATION, AND SEXUAL BEHAVIOR

The original wild form, the Sharptailed Finch, is monomorphic, and although there is great individual variation among Bengalese Finches, it is impossible to sex them from their appearance. However, I have found that song is an altogether reliable guide to the sex of a Bengalese; an unknown adult male will very soon indicate its sex by singing, while I have never known a female to sing. Juveniles begin to molt into adult plumage about two months after hatching, and at the same time the young males begin to sing. At first the song is no more than a very quiet whispering, while the bird holds itself in a somewhat stretched upright position: there is not usually any very well-defined posturing.

and only rarely are the belly feathers ruffled or is the tail raised, as in the adult song posture. During the next weeks the song gradually becomes louder and a fuller tone is developed, while slowly the adult song posture is assumed and also courtship display may sometimes be seen. By the age of about three months these changes are complete, the molt is finished and the birds may be considered mature, although they do not yet appear to be full grown. Young birds that have not been known to sing by this age (assuming they have been observed sufficiently) may confidently be taken to be females. I have determined the sex of all my birds in this way and have never found myself in error: all my presumed females eventually laid eggs when they were paired.

The Bengalese Finch is certainly able to breed at an early age. Occasionally, I left juveniles together rather too long and then found that they had gone to nest. One bird who was herself hatched on 18 June hatched her own first chick on 24 September; another year, birds hatched about 9 June had young on 3 October. Thus the Bengalese may be considered mature at three months, for they are then in adult plumage and capable of breeding. Given suitable conditions, they then apparently remain in constant breeding condition; it seemed to me that no individual ever went temporarily out of reproductive condition and neither was it ever obvious that a bird was in molt. Presumably feathers were shed and replaced very gradually. This was in marked contrast to some of our wild-caught species of estrildine (e.g., *L. castaneothorax*) in which the molt was very obvious. The breeding season of wild *L. striata* also tends to be prolonged, and may extend more or less throughout the year (e.g., Baker, 1926; Betts, 1952; Henry, 1955).

When breeding pairs were needed, males and females were taken from the stock cages and put together. The males almost invariably courted within a few minutes and sometimes succeeded in forcing a copulation, but only rarely did the female show solicitation on this first encounter. During the following few days the female usually responded by soliciting whenever the male courted her. The courtship of the Bengalese Finch has been described by Morris (1958), and there are photographs of it in Morris (1958) and Eisner (1957). The male moves along the perch toward the female with a series of bowing and pivoting movements in characteristic posture, singing continuously. If the female is responsive, she assumes a forward position and quivers her tail in a vertical plane (solicitation: cf. Morris, 1954; Moynihan and Hall, 1954); otherwise she flies off. From a few observations on pairs

placed in larger aviaries, I believe this sequence would normally be preceded by a period of flying about and carrying nest material, as has been described for *L. punctulata* (Moynihan and Hall, 1954), but this was very much reduced in my small cages. Moynihan and Hall describe how, after this period of carrying nest material, the male Spicebird goes into the courtship display: he drops the nest material, beak-wipes, and then begins to display. Beak-wiping at this point is not usual in the Bengalese. The first movement of the display is normally a very deep bow, after which the bird mainly pivots in a horizontal plane as he moves up to the female before mounting her. Although my birds were in small cages, my observations on courtship agree with those of Morris (1958).

At the time the birds were put into the breeding cages, some hay was placed in the nest box, and more was scattered around the cage. Although the birds often began to build within a few minutes of being put together and continued to build during the next few days, the nest was most changed about two days before the first egg was laid. However, I made no attempt to study nest building carefully, mainly because the birds could be allowed only a small amount of nest material since a larger amount would have impeded my observations later.

THE INTERVAL BEFORE THE FIRST EGG IS LAID

The first egg was usually laid about 7–10 days after the pair was put together, but I was interested to find that this interval varied with the season of the year, tending to be longer in winter. Table 2 shows records for virgin birds and birds with breeding experience separately: virgin birds seem to take rather longer than experienced birds to go to nest, but I have rather few records for them. The data on birds with breeding experience are also shown graphically in Figure 3, in the form of bimonthly averages of this interval.

TABLE 2
INTERVAL BETWEEN PAIRING AND LAYING OF FIRST EGG

	<i>Date put together</i>	<i>Interval in days</i>
A) experienced birds	Jan. 6 1957	7, 10, 10, 11
	Feb. 11 1957	10, 11, 12, 21
	Mar. 8 1956	7, 8, 9
	Mar. 12 1958	9, 9, 10
	Mar. 26 1957	2, 6, 8
	Mar. 29 1957	1*
	Apr. 9 1956	3, 7, 7
	May 6 1958	7, 8, 10
	May 7 1957	7, 9, 14
	May 8 1956	3
	June 4 1957	6, 7, 7, 7
	July 24 1958	5, 10, 11
	Aug. 8 1956	6, 7, 7, 8
	Aug. 13 1958	7, 7, 8, 8
	Sept. 4 1955	6, 6
	Oct. 3 1957	8, 8, 9, 11
	Oct. 4 1955	8
	Oct. 15 1956	6, 6, 10, 16
	Oct. 27 1957	6, 7, 7, 9
	Dec. 6 1956	8, 8, 9, 17
	Dec. 10 1957	7, 10, 18, 21 (66 cases)
B) virgin birds	Jan. 15 1956	10
	May 8 1956	12
	June 11 1956	15, 20
	Sept. 6 1956	7, 8, 18, 20
	Sept. 9 1956	11, 17
	Oct. 4 1955	9

* In this very surprising case, where the first egg was found within 18 hours of the birds being put together, a normal clutch of eight eggs was laid on consecutive days. The whole clutch proved to be infertile, but this cannot be considered significant, as infertile clutches are not rare; among their several previous clutches the same pair had already had one entirely infertile clutch and also one entirely fertile clutch.

As most of the few records of virgin pairs were obtained during the summer months, I compared records obtained between the March and September equinoxes for virgin and experienced birds, using the appropriate form of the t-test. (The virgin bird sample was too small for the nonparametric X^2 test to be used.) During the summer months, the mean interval before laying began was 6.9 days for the experienced birds and 14.2 days for the virgin pairs, and this difference is significant at 1 per cent ($t = 4.26$; 1 per cent value of $t = 3.32$). For comparison, the winter mean interval for the experienced birds was 10.0 days.

The records of the birds with breeding experience were divided at the solstices and the equinoxes, and comparisons were made using the X^2 test. The records of the interval before laying began differed very

significantly as between summer and winter (equinoctial division: $X^2_{(2)} = 9.92$, $0.01 > p > 0.005$). In contrast, division at the solstices produced no suggestion of difference of the records ($X^2_{(2)} = 0.16$, $0.95 > p > 0.90$). This suggests that the interval before laying begins may be influenced by the absolute daylength but not by whether daylength is increasing or decreasing. I cannot, however, say definitely that daylength is the relevant influence, although it seems the most probable one. The birds were kept entirely at natural daylength, in which the variation was considerable; variations in temperature were smaller and were much less consistent, and the birds experienced no seasonal variation in diet.

CLUTCH SIZE

Five or six eggs are most commonly laid in a clutch, but clutch size ranges from two to nine. Single eggs are occasionally laid, but I have never known them to be incubated, while the two-egg clutches were incubated. No difference between virgin and experienced pairs was

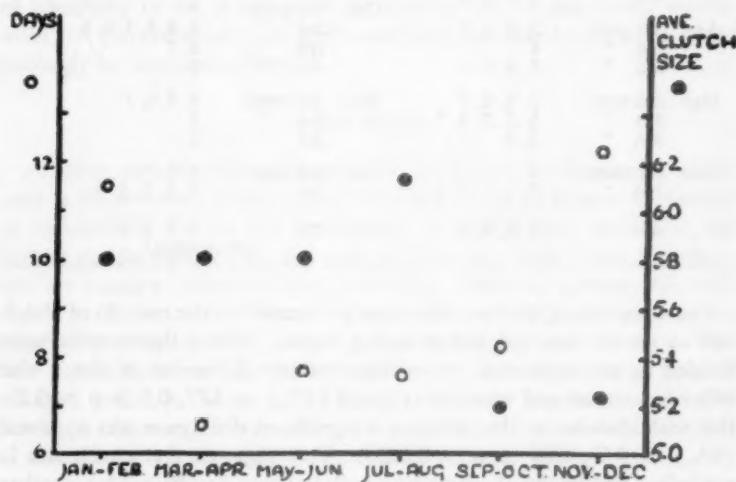


Figure 3. Seasonal variation in the interval before the first egg is laid (open circle) and in clutch size (solid circle). The points represent bi-monthly averages.

Note that the variations of the two measures are not in phase, clutch size being minimal from September to December, while the delay before the first egg is laid is greatest from December to February, probably indicating a differential sensitivity to photoperiod.

apparent, and I have not separated the records that are given in Table 3. Bimonthly clutch-size averages are presented graphically in Figure 3.

TABLE 3

CLUTCH SIZE

(In this table each month has been divided roughly into four "weeks." The markings indicate where the record was divided for testing.)

	<i>Approx. date of 1st egg</i>	<i>Number in clutch</i>		<i>Approx. date of 1st egg</i>	<i>Number in clutch</i>
Jan.	2nd week	6		July 1st week	7, 9
	3rd "	2, 5, 8		4th "	5
	4th "	5			
Feb.	2nd week	6		Aug. 1st week	6, 6
	3rd "	6		2nd "	5, 7
	4th "	6, 7, 7		3rd "	5, 5, 6, 6, 6, 6, 7
Mar.	1st week	6		Sept. 2nd week	5, 5, 5, 6
	3rd "	6, 6, 8		3rd "	5
	4th "	4, 6, 7, 8		4th "	4, 4, 5, 6, 6
Apr.	1st week	3, 5, 6, 9		Oct. 1st week	5
	2nd "	4		2nd "	4, 4, 5, 5, 6, 6
	3rd "	2, 6, 7		3rd "	5, 7
May	2nd week	5, 6, 6, 7		4th "	6
	3rd "	5, 5, 7, 7, 7			
	4th "	2, 5			
June	1st week	5		Nov. 1st week	5, 5, 6, 7
	2nd "	5, 6, 7, 7, 7		2nd "	5
	4th "	5, 6, 6, 6		3rd "	5
				Dec. 2nd week	6, 6
				3rd "	3, 5, 5, 5, 6
				4th "	3, 5, 6, 6
					(99 clutches)

For comparison, similar tests were performed on the records of clutch size as on the interval before laying began. When the records were divided at the equinoxes, no evidence of any difference in clutch size between summer and winter was found ($\chi^2_{(8)} = 3.77$, $0.3 > p > 0.2$). But with division at the solstices, a significant difference was apparent ($\chi^2_{(8)} = 8.58$, $0.05 > p > 0.025$). This suggests that clutch size is not influenced by the absolute daylength but may be affected by whether daylength is increasing or decreasing, larger clutches being more common in the springtime when daylength is increasing. It has, however, been suggested to me that, according to this interpretation, the high average for July-August is disturbing. That this value is higher than those of the preceding months is probably accidental, the samples not being large. That it is not lower, although the daylength is decreasing,

can be explained on the following grounds: however long the summer day, the birds habitually go to roost at about 6:00 P.M. (G.M.T.), while on the short, winter days they are constrained to roost at dusk. Thus the shortening of the days probably does not provide a significant stimulus until about the time of the September equinox, after which the birds are constrained to roost earlier than they would otherwise.

Frith and Tilt (1959) have found a comparable seasonal variation in clutch size in another estrildine, the Zebra Finch, in the wild. According to their data, the time of high average clutch size is the summer (November to March, in Australia). Thus, these data do not correspond with my findings, but it must be remembered that these wild birds are subject to a much wider range of potentially influential seasonal factors than were my captives.

Although no conclusion can safely be drawn until experiments under strictly controlled conditions have been carried out, the apparent contrast in the seasonal variations of the interval before laying begins and of clutch size is most interesting. If it is real, it suggests a high degree of specificity in the influence of photoperiod on the egg-laying mechanism. A physiological study under carefully controlled conditions would probably be very rewarding.

SEX RATIO

Another variable that appears to be influenced by the season of the year is the sex ratio of the young. The sex of my birds was determined at maturation, but as the postfledging mortality was negligible, the figures can be taken as the sex ratio at fledging. This means that there are two possible interpretations of the data: either the primary sex ratio (ratio at fertilization: Mayr, 1939; Landauer, 1957) may vary or the relative viability between fertilization and fledging may change. The first possibility seems the more likely to me. Although a large number of eggs failed to hatch (of 480 eggs laid and incubated, only 204 hatched), these eggs were almost always "clear" and showed no trace of an embryo, so that embryonic mortality except perhaps in the very earliest developmental stages must be ruled out. In addition, nestling mortality was not great. Table 4 shows the number of surviving young of the two sexes according to their approximate date of hatching: again, each month has been divided roughly into four "weeks." The markings indicate that the record was divided according to the season at which the birds were conceived, using a rough estimate of $2\frac{1}{2}$ weeks for the time between fertilization and hatching.

TABLE 4
SEX OF YOUNG BIRDS

<i>Approx. date of hatching</i>		<i>Number of males</i>	<i>Number of females</i>
Jan.	1st week	7	8
Feb.	1st week	1	2
	2nd "	2	2
Mar.	2nd week	5	1
Apr.	2nd week	10	7
	4th "	5	3
May	2nd week	7	2
June	1st week	3	3
	2nd "	7	4
	3rd "	3	3
	4th "	0	1
July	3rd week	3	5
Aug.		none	
Sept.	1st week	8	6
Oct.	1st week	2	5
	3rd "	1	4
	4th "	2	2
Nov.	1st week	3	5
	2nd "	5	10
	3rd "	0	2
	4th "	6	10
Dec.	1st week	1	0

(166 birds)

With an equinoctial division, the figures are suggestively but not significantly different ($X^2_{(1)} = 2.97$, $0.1 > p > 0.05$). However, division at the solstices showed a significant difference between the months when daylength was increasing and those in which it was decreasing, more males being produced in the spring and more females in the autumn ($X^2_{(1)} = 6.24$, $0.02 > p > 0.01$).

<i>Season of conception</i>	<i>Daylength</i>	<i>Males</i>	<i>Females</i>
Sept.-Mar.	short	33	46
Mar.-Sept.	long	48	39
Dec.-June	increasing	50	36
June-Dec.	decreasing	31	49

Division of the year into quarters is also interesting because it suggests how the sex ratio changes in the course of the year.

Dec.-Mar.	short, increasing	15	13
Mar.-June	long, increasing	35	23
June-Sept.	long, decreasing	13	16
Sept.-Dec.	short, decreasing	18	33

This suggests that both absolute daylength and daylength changes are influential, as apparently the sex ratio is balanced during two quarters and unbalanced in opposing directions in the other two quarters. These ratios were tested against the null hypothesis that males and females are produced in equal numbers, using the X^2 test with Yates' correction. The last category gave a significant difference ($X^2_{(1)} = 4.78$, $0.05 > p > 0.02$), showing that during the autumn significantly more females than males were produced, but the ratio for March-June did not show a significant difference ($X^2_{(1)} = 2.09$, $0.2 > p > 0.1$). The ratios in the other two categories were quite consistent with the null hypothesis ($X^2_{(1)} = .036$, $0.9 > p > 0.8$ and $X^2_{(1)} = 0.14$, $p \approx 0.7$), indicating that there is no departure from an equal sex ratio in December-March and June-September. Comparison of the March-June and September-December records showed these were very significantly different ($X^2_{(1)} = 6.82$, $0.01 > p > 0.005$).

LENGTH OF INCUBATION AND NESTLING PERIODS

The following convention was used: the day of beginning incubation, or of hatching, is called day 0, the following day is day 1, etc. Nests were normally inspected at about midday each day, although sometimes more frequently. Thus a 16-day chick is one that was found hatched on day 16 of incubation, making an incubation period of between 15 and 16 days.

In order to have broods in which the chicks were homogeneous in age, in many cases I replaced the eggs as they were laid by dummy eggs. These were in fact plastic model canary eggs, which are commercially available, and were therefore slightly larger than the eggs of the Bengalese Finch and pale blue instead of white but were none the less accepted immediately. The dummies were removed and the eggs replaced when the particular pair I wished to watch had five eggs, the other pairs at that time having perhaps one or two more or less. A difficulty commonly found in assessing the length of the incubation period is that of knowing precisely when the incubation of each egg began (cf. Swanberg, 1950). This difficulty was eliminated in those cases where the eggs had been replaced by dummies and no further eggs were laid after the clutch was returned to the nest (in which case regular incubation behavior was certainly established by this time). Seventy-one chicks were hatched from such clutches, and from these the incubation period may be estimated as 16 days (mean = 16.44 days, less half a day probable observational error). The distribution was as follows: 15 days—14 chicks; 16 days—28 chicks; 17 days—

15 chicks; 18 days—12 chicks; and 19 days—2 chicks. This sample represents fairly well my experience in all cases, in many of which the beginning of incubation was known with only very little less precision, except that it contains too many 15-day chicks. Of 59 chicks hatched from clutches in which one or two eggs were laid after the dummies were removed, only one was hatched at 15 days. Fifteen-day and 19-day incubation periods are definitely unusual. The records in which incubation periods were known exactly are given in Table 5; brackets enclose all the chicks from one clutch, and clutches incubated at the same time are shown together.

TABLE 5
LENGTH OF INCUBATION

<i>Date of beginning of incubation</i>	<i>Days of hatching</i>
Jan. 30 1956	(16, 16, 16, 17)
Feb. 26 1957	18
Mar. 21 1956	(17, 17, 17)
Apr. 8 1957	16; (16, 16, 17)
Apr. 20 1956	(18, 18, 19)
May 19 1956	17
Aug. 20 1956	(15, 15, 15, 17, 17); (16, 16, 17); (15, 15, 15, 18); (15, 15); (15, 15, 15, 15)
Sept. 15 1955	17
Oct. 1 1956	(16, 17)
Oct. 16 1957	(15, 16, 16)
Oct. 17 1955	18; (18, 18, 18)
Nov. 9 1957	(15, 16, 16, 16, 17); (16, 16, 17, 18); (16, 16, 16, 16, 17)
Dec. 19 1956	17; (16, 16, 16, 18)
Dec. 20 1955	(18, 18, 19)
Dec. 22 1957	(16, 16, 16, 16)

These records suggest that variation in incubation periods is probably not caused mainly by a variability among the eggs, as the incubation period within a clutch tends to be fairly uniform and also separate clutches incubated at the same time tend to hatch simultaneously. This sample is too small to show the latter tendency reliably, but my other, less precise, records do confirm it. It therefore seems that the incubation period is influenced by some outside factor that can affect several pairs simultaneously, but it is not obvious what this factor may be as there is no suggestion of any seasonal trend. One might expect that development would be quicker in warm weather and slow when it is cold. However, only extreme outside temperatures really influenced the temperature at which the birds were kept. The rapid hatching of the clutches laid in late August 1956 certainly cannot be attributed to

unusual heat, while the weather was unusually cold during February 1956, but the clutch incubated at this time did not take long to hatch.

It is also of interest to see how hatching is spread when there has been no interference with the clutch, *viz.*, when dummies were not used. As the eggs are normally laid daily and my impression is that regular incubation usually begins with the antepenultimate egg, the majority of the chicks would be expected to hatch more or less simultaneously and the remaining two to hatch on the two following days. This expectation only approximately fits the observed facts. Only records where all or nearly all of the eggs in the clutch hatched are of interest in this context, and these are given below:

5 eggs laid Apr. 3-7	chicks hatched Apr. 21, 22, 22, 23, 25
6 " May 22-27	" June 9, 9, 10, 11, 12 (1 sterile egg)
3 " May 31-June 2 +2e. June 4-5	" June 18, 18, 18, 19, 20
5 " June 1-5	" June 19, 20, 20, 20 (1 sterile egg)
6 " Oct. 25-30	" Nov. 12, 12, 12, 13, 14 (1 sterile egg)
5 " Nov. 11-15	" Nov. 29, 30, 30, Dec. 1, 1.

My records of the time of fledging are less satisfactory. This is largely because fledging is not so well defined an event in estrildines as it is in most other groups of passerine birds. The chicks do not leave the nest once and finally, but instead frequently return to it and invariably roost in it. I define fledging in the Bengalese Finch as the first leaving of the nest without obvious provocation, and one is unlikely to determine this accurately without considerable observation of the nest as at first the chicks spend only very short periods outside it. I am convinced that the majority of broods fledge on day 24 or 25, while fledging on day 26 or 27 is not uncommon. If the chicks are underdeveloped, fledging may be delayed as long as the 30th day. I have no record of fledging before day 24: I think fledging on day 23 is possible but would be very unusual, and I consider it most unlikely that Bengalese could fledge normally before this age. In this I disagree with many of the avicultural books, and this disagreement can probably be explained because the young birds will leave the nest upon disturbance, and are capable of flying, considerably earlier—probably as early as day 19. The discrepancy between the usual published estimates of the incubation period and my data can perhaps be explained by the fact that the former may well have been measured from the time of laying of the last egg. Steinbacher and Wolters (1956), probably the most reliable of the avicultural books, gives the incubation period of the Bengalese Finch as 12-15 days and the age at fledging as 21-27 days. Perhaps another reason for the commonly accepted short estimates is

that my estimates would seem to be unusually long for an estrildine, both according to the published information and to our own experience with other species.

The fledgling Bengalese Finches begin to feed themselves about a week after they leave the nest, and can safely be separated from their parents within a fortnight of fledging. Indeed, the adults may begin to lay a new clutch as soon as 10 days after the young have fledged, and they then cease to feed the fledglings.

SUMMARY

This paper presents data accumulated during four years' study of the Bengalese Finch under fairly controlled conditions in captivity. A brief account of the management of the birds is given, after which the following main points are discussed:

1. The occurrence and form of nestling mouth markings has been thought of considerable importance in estrildine taxonomy. It is therefore of interest that the mouth markings of nestling Bengalese are not constant. The Bengalese is a domesticated piebald, and the variations in the nestling mouth markings are correlated with plumage variations.
2. There is seasonal variation both in the time from the introduction of a pair to the laying of the first egg, and in clutch size, but the variations in these two factors are not in phase. If, as seems most likely, these variations are responses to changes in photoperiod, this suggests a high degree of specificity in the influence of photoperiod changes upon reproductive mechanisms.
3. The sex ratio of the young also shows seasonal variation, more males being produced in spring and more females in autumn.
4. Data on the length of incubation and nestling periods are given.

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LATE NORTH AMERICAN SPRING MIGRANTS IN MEXICO

BEN B. COFFEY, JR.

Of the 10 birding vacations that Mrs. Coffey and I have undertaken in Mexico since 1946, five have been in late spring and one in late April. As a result, one of our special interests was that of observing the extent of the spring migration of North American species through eastern and southern Mexico. Published data on such species at this season appear to be limited. Stevenson (1957) in his study of trans-Gulf and circum-Gulf migration was able to use data from only two Mexican regions, one somewhat inland and one coastal. For the latter he relied greatly on Loetscher's recent (1955) and comprehensive summary of migrants in Veracruz. At times we will make direct comparison with the latter summary, since for much of our time we were in Veracruz. Among other recent data are those of Amadon and Eckelberry (1955). The significance of data in general works such as Bent's Life History series cannot always be gauged. We do not usually know whether the extreme dates are based on a few or on many observations.

From 20 May through 10 June 1951, we went as far as the highway's end just south of Catemaco, Veracruz. From 17 May through 6 June 1953, we rushed to the end of the Inter-American Highway, at the Guatemalan border, then lingered at Las Casas, Chiapas, and detoured to Veracruz. From 9-30 May 1954, our route was chiefly in coastal Veracruz, from Tampico through Tuxpan to the Isthmus, crossing it and visiting Las Casas, returning by the Oaxaca-Laredo route. This circuit was repeated as far as the Isthmus, 27 May through 11 June 1955, omitting the Tuxpan leg, but 12 May through 1 June 1957, reversing the circuit, we reached the Guatemalan border again, spent a week at Las Casas, then returned along the coast. Since the coast was worked last, we missed the bulk of the swallows then, as also, due to a delayed start, in 1955. Our 1958 trip does not enter into our data frequently since it was from 19 April through 4 May, going down the Veracruz coast (Tantoyuca, Tuxpan, Coatzacoalcos) and returning, Tehuantepec, Oaxaca, to Laredo.

Some of the species have been noted only sparingly by collectors in the states we covered, based on the ranges as given in the Mexican Check-list (Friedmann *et al.*, 1950 and Miller *et al.*, 1957) from known specimens. Where our observations are apparently the first from those states, we have indicated this with an asterisk.

Most of our transients were seen near the coast, and the swallows outnumbered all others. Unfortunately, we could not always be at favored localities, such as the Tecolutla-Nautla strip, at the best hours of the day. In 1958, although we arrived earlier than in previous years, we found the shorebird "pits" and Laguna Chila near Cacalilao dry, which may have been a frequent condition in the past and could thus explain the scarcity of records and reports of shorebirds on the coast. Conditions were generally favorable on the three previous spring visits. Most of the shorebirds and other waterbirds appeared to be transients, especially the flocks, but some were, undoubtedly, stragglers. Eisenmann (1951, 1957) has reported northern birds summering in Panama, the writer has noted such stragglers on our Gulf Coast, and other observers have made similar observations.

Many of the waterbirds were noted at pits along the Tampico-Valles highway, in Veracruz. According to the AMA highway guide, the state line was at Kilometer 134.6 and Cacalilao, a village on the first rise, at K101.3. Large pits were marked by K125 (near Tamos, a rail junction on the map and a locality of Loetscher's). Since our visits the kilometers have been reversed, and the large pits are between K9 and K10. Others extend from K16 to K26. At about K18 a road goes along Laguna Chila to a Pemex Estacion, said to be "Caracol." This general area is referred to as east of Cacalilao.

Pelecanus erythrorhynchos. White Pelican. On 29 May 1951, we saw a flock of 52, while on a scheduled launch trip between Tlacotalpan-Alvarado. Our 1958 flocks were 80 near Cacalilao, 20 April, and 180 north of Alvarado, 24 April. Loetscher's late date is 16 April, from Wetmore (1943: 232). In Tamaulipas* we saw 4 at Alta Mira, 28 May 1955, and on 20 May 1951, south of Matamoros, we saw 37, 3, and 13, respectively—apparently the first state report. For the first published report see Amadon and Eckelberry (1955: 68). (On 20 November 1956, we saw 72 at Lomas del Real, Tamps.)

Anas strepera. Gadwall. Fourteen west of Nautla, 29 May 1957; our only spring sighting. (Up to 3 noted (BCs, R. B. Fischer) in the Huichihuan-Jalpilla area, San Luis Potosi,* on 28 November and 10 and 11 December 1948.)

Anas carolinensis. Green-winged Teal. We rarely saw this species. One was east of Cacalilao, 28 May 1955. (Two were seen on the Rio Huichihuan, near Jalpilla, San Luis Potosi,* 11 December 1948 (BC, R. Fischer).)

Anas discors. Blue-winged Teal. Small numbers seen east of Cacalilao, as late as 31 May (1957), three pairs west of Nautla, 13 May

1954, 20 from the Alvarado-Tlacotalpan launch, 29 May 1951, and 2 males near Tehuantepec, 17 May 1957.

Mareca americana. American Widgeon. Saunders reports it common in Veracruz* according to Loetscher (1955: 23), where we have seen small flocks in winter. Our late spring reports here are: a total of 16 from the Alvarado-Tlacotalpan launch, 29 May 1951, and 1 on Lake Catemaco, 4 June 1955.

Spatula clypeata. Shoveler. Common east of Cacalilao, Veracruz, through 31 May (1957), at least; reported common by Saunders (Loetscher, 1955: 23). On 2 December 1948, we saw 2 northeast of Tehuantepec, Oaxaca*; Amadon and Eckelberry (1955: 67) found the species there 22 May 1952. On 25 November 1956, we had 5 near Chilpancingo, Guerrero,* and 14 scattered, the next day, north of Acapulco. The 1956 birds were all in fall plumage.

Oxyura jamaicensis. Ruddy Duck. East of Cacalilao, 100 on 30 May 1955, and 5 on 31 May 1957; Lake Catemaco, 45, on 4 June 1955; Lake Alchichica, Puebla, 5 on 2 June 1951. In Hidalgo,* 3 noted near Jacala, 9 June 1955 (and 20 there 22 November 1956). Loetscher (1955: 24) quotes Saunders that a few remain in summer, according to local informants, in the Tampico area, but the 100 reported above, in that area, were evidently transients. The species breeds elsewhere in Mexico, but its status at the other points above is unknown.

Squatarola squatarola. Black-bellied Plover. In Veracruz 1 was seen 27 May, between Boca del Rio and Anton Lizardo, while flocks of 6 and 21 were seen 31 May, east of Cacalilao. Loetscher's latest is 10 May—5 at Veracruz. (One on 27 November 1956 at Colonia Copacabana, south of Puerto Marques, is apparently the first report for Guerrero.*)

Arenaria interpres. Ruddy Turnstone. The Check-list shows only the Yucatan peninsula for the east coast, but Loetscher (1955: 26) reported it common for Veracruz.* Our only reports were at Coatza-coalcos, 1 on 17 May 1954, and 1 on 4 June 1955.

Capella gallinago. Common Snipe. One, 10 May 1954, Alta Mira, Tamaulipas. (One we saw is apparently a first report for Puebla.* On 30 November 1948, I found 1 in a very small meadow, wet from an irrigation ditch above, near Los Molinos, 15 miles south of the city of Puebla.)

Numenius phaeopus. Whimbrel. For Veracruz* Loetscher (1955: 27) quotes Dr. George B. Saunders, "Regular spring transient along

the coast." Our only May record was of 1 at K10, east of Cacalilao, 11 May 1954.

Numenius americanus. Long-billed Curlew. Twelve were seen 31 May 1957, along Laguna Chila (Cacalilao), Veracruz. (Two, 27 November 1956, at Colonia Copacabana, Puerto Marques, are apparently the first reported for Guerrero.*)

Actitis macularia. Spotted Sandpiper. One seen at Lake Catemaco, Veracruz, 4 June 1955. A very few on both sides of the Isthmus, 17-19 May 1954, and 1 near Tehuantepec, 22 May 1953; 1 on 21 May 1951, north of Ciudad Mante, at a ditch near K601.

Totanus melanoleucus. Greater Yellowlegs. East of Cacalilao, Veracruz: 2 on 11 May 1954, 1 on 29 May 1955, and 1 on 31 May 1957. Loetscher (1955: 27) gives a date of 10 May for both yellowlegs. (On 25 November 1956, I found 2 at a small lake near Chilpancingo, Guerrero.* North of Acapulco, 26 November, we listed 5 individuals, and south, 27 November, we tallied 3.)

Totanus flavipes. Lesser Yellowlegs. East of Cacalilao, we saw a total of 11 on 11 May 1954, while on 31 May 1957, we saw 3, then a flock of 45, which surely must have been transients. A scattered 14 were seen 12 May 1957, along the Matamoros-Victoria highway. Northeast of Tehuantepec we had 1 on 18 May 1954, and again, 17 May 1957.

Erolia melanotos. Pectoral Sandpiper. Loetscher (1955: 28) gives a "latest" date of 11 May. Scattered along the Matamoros-Victoria highway, 12 May 1957, we saw a total of 18; on 20 May 1951, only 5. East of Cacalilao 11 May 1954, we listed 26 (two flocks). Two days later we had 9, west of Nautla. On 17 May 1957, we saw 2 northeast of Tehuantepec, and next day, 2 just north of Teopisca, Chiapas. (Our winter reports are: Cacalilao, 12, on 21 November 1956; Tecolutla, 5, on 7 December 1949; Veracruz to Alvarado, 5, on 2 December 1956. The Check-list does not indicate presence at this season.)

Erolia fuscicollis. White-rumped Sandpiper. Another species treated by the Check-list as unrecorded except from the Yucatan peninsula. Loetscher (1955: 28) saw 1 on 10 May 1939, near Veracruz.* On 20 May 1951, we saw 6 along the Victoria highway south of Matamoros, Tamaulipas.* In the roadside pits east of Cacalilao we saw 5 on 11 May 1954, and 3 on 31 May 1957, and a nice flock in May 1955. We counted 57 on the 28th, then next day had 80 at the same spot, with 25 others nearby. Having to turn back that night (below Tantoyuca), we returned to the pit 30 May, but found rain had raised the water level so that all small shorebirds were gone, at least from that locality. We

spent much time with the White-rumped, relearning their weak, wiry notes.

Erolia bairdii. Baird's Sandpiper. East of Cacalilao, 29 May 1955, I was able to get close to 4 Baird's, at a hidden pit crowded with ducks, Avocets, etc. Our only record. Loetscher (1955: 28) gives no recent spring record for Veracruz. Amadon and Eckelberry (1955: 67) saw 4 on 12-14 May 1952, "on the south side of the river in Oaxaca." According to highway markers, the state line at this point is not at the Rio Jaltepec, but five miles south, so this may be another Veracruz report. Bent (1927: 200) gives late dates of 19 May for Mexico, D.F., and 1 June for Iguala, Guerrero.

Micropalama himantopus. Stilt Sandpiper. Cacalilao, 11 May 1954, a total of 230 (80, largest group) at one series of pits, plus 21 to the west. Loetscher (1955: 28) gives only one report—8 seen, 14 March 1939, at Isla, Veracruz.*

Ereunetes pusillus. Semipalmated Sandpiper. One was seen 12 May 1957, between Matamoros and San Fernando, Tamaulipas.* East of Cacalilao we saw 40 on 29 May 1955. On 18 May 1954, we had 1 at the Rio Jaltepec (Veracruz) on the Isthmus highway, and the next day, 3, east of Tehuantepec, Oaxaca.* The Check-list carries this species as unrecorded in Mexico, except from the Yucatan peninsula. Loetscher (1955: 28) gives several August-September reports for Veracruz,* including a collection by G. B. Saunders. We had good looks at legs and bill. (Other records were: 7 December 1949, 20, near Tecolutla; 21 November 1956, variously, east of Cacalilao—2, 200, 300, 2, 1.)

Ereunetes mauri. Western Sandpiper. East of Cacalilao we saw 8 on 29 May 1955, and along the Coatzacoalcos beach, 1 on 4 June 1955. (Only 1 other seen—4 December 1956—near the latter town.)

Limosa fedoa. Marbled Godwit. One was seen 11 May 1954, east (K10) of Cacalilao, Veracruz.* Not listed for Veracruz in the Check-list, nor by Loetscher (1955).

Limosa haemastica. Hudsonian Godwit. Not in the Check-list. Blake (1953: 140) gives a sight record for Salina Cruz, Oaxaca, July 1952, by Irby Davis and Richard Herbert. On 12 May 1957, in Tamaulipas, from the Victoria highway, 46 miles south of Matamoros, I saw 2 with a few smaller shorebirds, on a low, undrained area of a cotton field. It was necessary to wade in close in order to make them fly and show the wing and tail pattern. At K9, east of Cacalilao, Veracruz, I studied and flushed another, 31 May 1957, and a third, 20 April 1958. Four were seen at close hand, 19 April 1958, at 36

miles south of Matamoros. These are apparently first reports for the two states and second to fifth reports for Mexico.

Recurvirostra americana. American Avocet. Loetscher (1955: 28) found only three undated records for Veracruz, two being published in 1881. We saw this species on four trips past the highway pits, east of Cacalilao. Totals were: 11 May 1954—10; 28–30 May 1955—110; 31 May 1957—21; 21 November 1956—76.

Steganopus tricolor. Wilson's Phalarope. Loetscher (1955: 28) found only an 1864 published record for Veracruz. On 11 May 1954, at six points east of Cacalilao we totaled 51; a Kodachrome photograph was made of a few, with some Avocets. Apparently the first report for Tamaulipas* is that of 8 females and 2 males seen 12 May 1957, 15 to 30 miles south of Matamoros. Farther down the Victoria highway we saw a single male.

Larus argentatus. Herring Gull. On 31 May 1957, east of Cacalilao, we saw 7. Loetscher's latest record (1955: 29) was 10 May.

Larus pipixcan. Franklin's Gull. This species does not appear on many lists, but we have a number of records for late May (and a few in winter). They range from 110 at Tehuantepec, 22 May 1953, and along the coast from 50 near Coatzacoalcos, 26 May 1957, to 22 between Nautla and Tecolutla, 1 June 1951. On 28 May 1957, wind 25 mph, northeast, we noted 12 gulls low over fields, east of Perote, Veracruz, too fast to identify. West of Perote, we saw 12 and identified them as Franklin's; then down at the edge of Lake Alchichica, Puebla, I leisurely studied 2 Franklin's Gulls through a 20x Balscope. (Two at Salina Cruz, 2 December 1948, are apparently the first Oaxaca* report.)

Gelochelidon nilotica. Gull-billed Tern. On 27–28 May 1951, 6, just southeast of Alvarado; 28–29 May 1955, 2 near Cacalilao (also 6 here, 19 April 1958). Our only other sighting is a winter report for Guerrero—1 on 26 November 1956, north of Pie de la Cuesta.

Sterna hirundo. Common Tern. On 10 May 1954, 2 at Alta Mira, Tamaulipas, and 26 May 1957, 20 near Coatzacoalcos (also 260 there—5 with bands—4 December 1956).

Hydroprogne caspia. Caspian Tern. Loetscher (1955: 30) refers only to two winter areas in Veracruz.* On 31 May 1953, we saw 1 at Boca del Rio, and 1 the next day, from the road from there to Anton Lizardo. On 17 May 1954, we had 10 at Coatzacoalcos. (Also rarely seen on winter trips. First state reports, apparently, are: 2 December 1948, 4 at Salina Cruz, Oaxaca*; 20 November 1956, 1 at Lomas del Real, Tamaulipas.*)

Chlidonias niger. Black Tern. Five at Lake Alchichica, Puebla, 2 June 1951, and 2 northeast of Tehuantepec, 17 May 1957. Loetscher (1955: 30) gives no spring dates for Veracruz. At Coatzacoalcos we had 25 on 26 May 1957. Southeast of Alvarado we saw 40 on 27 May 1951, and a total of 40 from the Tlacotalpan launch, two days later. North of Nautla we saw 15 on 31 May 1951. At Laguna Chila, Cacalilao, we noted 230 on 31 May 1957. (None noted, mid-April 1958.) Stevenson (1957: 59) comments on the lack of spring records from Mexico.

Tyrannus tyrannus. Eastern Kingbird. In 1954 in Veracruz we saw 1 south of Tecolutla, 13 May, 6 in the dune area just east of Veracruz city, 16 May, 1 northwest of Coatzacoalcos, 18 May, and that evening, 9, from the Isthmus highway and 24 miles south of Acatlán. In 1957 we had 1 between Matamoros and San Fernando, 12 May, and 7 (with *M. forficata*) northeast of Tehuantepec, 17 May. Stevenson (1957: 59) mentions the lack of large numbers in data from Mexico. This agrees with our experience cited above and also for an earlier period of the season, since 2 in the city of Veracruz were the only ones we saw during our 19 April–4 May 1958 trip. However, Amadon and Eckelberry (1955: 67) mention "hundreds" in the middle of the Isthmus, 12–14 May 1952. (In winter we saw only 1—near Taxco, Guerrero,* 28 November 1946.)

Muscivora forficata. Scissor-tailed Flycatcher. Mid-May flocks were 28 birds south of Tecolutla, 13 May 1954, and 35 (two groups) about 20 miles northeast of Tehuantepec, 17 May 1957. Later birds were: 22 May 1953, 2, northeast of Tehuantepec; 25 May 1957, 1, northwest of Coatzacoalcos; 27 May 1957, 1 at K11, Boca del Río–Antón Lizardo highway; 28 May 1955, 1 between Ciudad Mante and Manuel. One at the north end of the Monterrey airport, 1 June 1957, may have been summering.

Iridoprocne bicolor. Tree Swallow. Three were seen at Tecolutla, 12 May 1954, and 1 at Monte Albán, near Oaxaca, 16 May 1957. (Apparently the first report for Morelos* is that of a flock of 500 high over the Cañon del Lobo, between Cuernavaca and Yautepec, 24 November 1956. Later that day we saw flocks of 10 and 50, Cuautla to Amayuca, and 30 and 20 south of Yautepec.)

Riparia riparia. Bank Swallow. Near K601, north of Ciudad Mante, we saw 1 on 21 May 1951; but it was a flock of 8, passing by rapidly, with 40 Barn Swallows, 23 May 1953, at the far end of the country, that interested us in checking for transients. This was just north of the Museum of Zoology, Tuxtla Gutiérrez, Chiapas. Another

20 Barn Swallows followed. During the evening of 12 May 1954, we saw 40, then 300, near Tecolutla. From the Hotel Marsol there, at 7:45 A.M. the next morning, Mrs. Coffey estimated 100 swallows a minute passing northward, parallel to the shore. This flight, ending at 8:00 A.M., was about one-fourth Banks and three-fourths Barns. Driving south from there, at 11 A.M. we counted 100, 25, and 25 Bank Swallows. Then we met a flight of about 7,000 swallows, mostly Barns and Banks, ending at 11:45 A.M. Twelve miles west of the coast (and Nautla) we saw 30, but no others toward Tezuitlan. On 16 May 1954, we saw over 25, Paso del Toro to Alvarado, and 6, south of Catemaco the next day. In 1955 we saw 15, Panuco to Tempoal, 29 May, while in 1957 we had one, 28 May, at El Lencero, near Jalapa. Loetscher (1955: 35) saw 12 at Jalapa, 6 May 1939, the only report for Veracruz (and apparent basis for inclusion there, in the Check-list), but stated the species should be a regular transient. In 1957 we reached the Tecolutla coastal strips in midafternoon and could not remain over.

Stelgidopteryx ruficollis. Rough-winged Swallow. We have no late records. Since Stevenson states that numbers reported from eastern Mexico have been comparatively small, we might mention that in 1958 we witnessed a good migration, 22 April, during our drive from Tecolutla to Nautla, a heavy movement, 24 April, from Veracruz southeast, and a small number (230), 26 April, near Coatzacoalcos. Because of widespread summer distribution in the areas we covered, it would be difficult to differentiate smaller numbers.

Hirundo rustica. Barn Swallow. See also under *Riparia riparia*. Small flocks noted 26-29 May 1951, Boca del Rio to Catemaco (and Tlacotalpan) and again, 16-18 May 1954, down to Coatzacoalcos. On 22 May 1954, we saw flocks of 20 and 12 near Tuxtla Gutierrez. In 1957 we drove the coastal route on our return, missing all but a few transients. Our latest were 6 near Tecolutla, 1 June 1951. All coastal area birds should be northbound transients. (Small numbers seen in Veracruz, early winter; 2 December 1948, 8 at Salina Cruz, and 4 the next day, northwest of Tehuantepec.)

Bombycilla cedrorum. Cedar Waxwing. Loetscher (1955: 37) gives 8 May as the latest spring record for Veracruz. On 11 May 1954, we saw 26 and 20, from Tampico Alto to Tuxpan. On 14 May 1954, we noted 28 below La Joya, Veracruz; in Puebla that day we had 15 at Tezuitlan, and 6 northeast of that city.

Dendroica magnolia. Magnolia Warbler. In the dunes, south environs of Veracruz city, 16 May 1954, we saw 3, and 18 miles north of Acayucan, the next day, we saw a male. Bent (1953: 210) gives a

27 April date for Minatitlan, while to the south of it Amadon and Eckelberry (1955: 67) found the species, 12–14 May 1952.

Dendroica virens. Black-throated Green Warbler. On 10 May 1954, we saw a male, 20 miles from Ciudad Mante on the Tampico highway. Records near San Cristobal de Las Casas, Chiapas, in 1957, were: 1, four miles west, 19 May; 1, seven miles east, 22 and 23 May; below Cate Pass, 2 on 20 May. At the first Las Casas point, we had also noted 1 on 26 May 1953. Bent (1953: 306) gives the late date of 11 May—in Tamaulipas.

Dendroica fusca. Blackburnian Warbler. A female was seen 15 miles southeast of Catemaco, 17 May 1954, and 1 of each sex, 20 May 1957, below Cate Pass in Chiapas.

Seiurus aurocapillus. Ovenbird. One seen 19 May 1953, in Chapultepec Park, Mexico, D.F.

Wilsonia pusilla. Wilson's Warbler. On 14 May 1954, we saw a male Wilson's at Tezuitlan, Puebla, another in Veracruz, southeast of Jalacingo, and 2 females southeast of Jalapa. Amadon and Eckelberry (1955: 67) reported the species in mid-Isthmus, 12–14 May 1952.

Passerina cyanea. Indigo Bunting. Northwest of Coatzacoalcos, Veracruz, I saw 2 males and 4 females, 18 May 1954. Early season sightings were also scarce.

Spiza americana. Dickcissel. Between Matamoros and San Fernando, Tamaulipas, we encountered a total of 180 on 12 May 1957. Loetscher (1955: 46) gives the latest date of 18 May for Veracruz.

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ADDITIONAL NOTES ON THE PLUMAGE OF THE REDWINGED BLACKBIRD

ROBERT W. NERO

INTRODUCTION

In a previous report on plumage aberrations in the Redwinged Blackbird (*Agelaius phoeniceus*), I (1954) pointed out the high frequency of occurrence of certain albinotic traits in this species. The results of a detailed examination of a random sample of more than 200 adult males that were collected near Madison, Wisconsin, were particularly interesting. Recently, I have been able to make a similar analysis of a large sample collected near Regina, Saskatchewan, the results of which are reported below. In addition, an analysis of variable black patterns of the middle coverts of the wing and brief experiments on the red pigmentation of the wing coverts are described.

FREQUENCY OF OCCURRENCE OF ALBINOTIC TRAITS IN ANOTHER SAMPLE OF REDWINGS

One hundred territorial adult male Redwinged Blackbirds were collected within 60 miles of Regina between 14 May and 12 July 1956. Examination of this sample for albinotic plumage aberrations showed a close similarity with results obtained in a previous study (Nero, *op. cit.*) of 219 collected near Madison, Wisconsin (see Table 1).

TABLE 1

FREQUENCY OF OCCURRENCE OF FIVE ABERRANT PLUMAGE TRAITS IN
ADULT MALE REDWINGED BLACKBIRDS FROM TWO LOCALITIES

Trait	Per cent Regina	Per cent Madison
"Red Spotting"	34	27
"Breast Banding"	15	11
"Metacarpal Red"	21	20
"White Belly-spot"	19	23
"White Tail-base"	90	88

A comparison of the range of variability of a single one of these traits—"white tail-base" (depigmentation of the base of the tail feathers)—between the Madison and Regina samples is shown in Table 2.

TABLE 2

COMPARISON OF THE RANGE OF VARIABILITY OF A SINGLE
ALBINOTIC TRAIT—"WHITE TAIL-BASE"

<i>Extent (maximum length of white area in mm.)</i>	<i>Per cent Regina (100 birds)</i>	<i>Per cent Madison (127 birds)</i>
1-5	7	11
6-10	22	29
11-15	37	42
16-20	20	12
21-25	4	2
25 (and over)	0	4

The similarity of occurrence of all of these traits in two widely separated populations suggests that in the Redwinged Blackbird these plumage aberrations are characteristic of the species. The evolutionary significance of specific albinotic traits, particularly "breast banding," which is sometimes visible in the field, is not clear.

THE VARIABILITY OF BLACK PIGMENT PATTERNS IN THE
MIDDLE COVERTS OF THE WING

According to Baird, Brewer, and Ridgway (1905: 160), "The middle coverts are usually uniform brownish-yellow to the very tips; sometimes some of these middle coverts are tipped at the end with black, but these black tips are usually of slight extent, and indicate immaturity, or else a transition of hybridism or race to *A. gubernator*." In nearly all of the adult male redwings collected at Regina and Madison (above) one or more of the innermost (or proximal) middle (or greater) secondary wing coverts (which comprise the buffy row of feathers bordering the

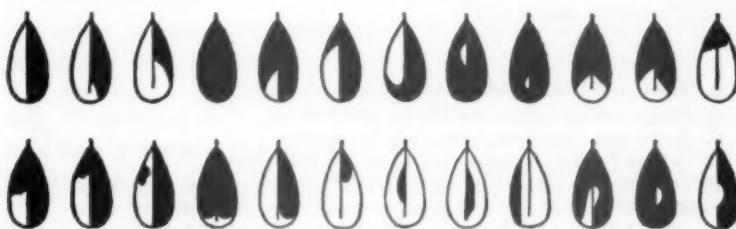


Figure 1. Some typical representative patterns of individual pigmented proximal middle wing coverts selected from a number of birds to show the variation (all left wing, dorsal view).

red epaulet) exhibited variable patterns of black and buff (see Figure 1). Being intrigued by the regularity of the patterns of pigmentation, I made the following observations of this minor aspect of the plumage of *A. phoeniceus*.

The extent of melanic pigmentation on the proximal coverts of the birds in my samples varied from a small spot on the medium web of the innermost or first feather to complete pigmentation of the first, second, and rarely third feather in this row. Whatever the pattern in an individual bird, it tended to be the same, though reversed, on comparable feathers of the other wing. A high degree of such symmetry was exhibited by 64 per cent of the 100 birds collected at Regina (above). The others had patterns that were considered to be asymmetrical. Moreover, in about 70 per cent of the sample a regular progression of pigmentation from medial to lateral was evident: pigmentation was complete on the median web of the first feather before it appeared on the lateral web at all, and pigmentation was complete on the entire first feather before it appeared on the median web of the next feather. Idealized progressive pigmentation patterns for this group (67) are indicated in Figure 2.

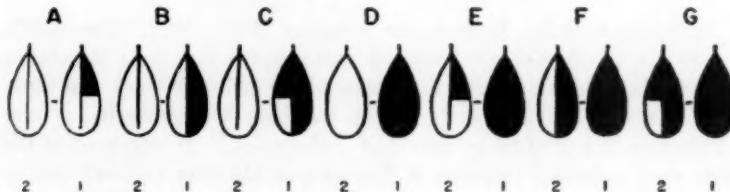


Figure 2. Stylized pigmentation patterns of first and second median coverts, and distribution in one sample of 67 that were the same on both wings (left wing, dorsal view).

	Sample
A. Inner web incomplete	6
B. Inner web complete, no black outer web	3
C. Inner web complete, outer web incomplete	20
D. Whole feather complete, no black second feather	11
E. First feather complete, incomplete inner web second feather	24
F. First feather complete, complete inner web second feather	3
G. First feather complete, incomplete outer web second feather	0

These patterns generally conform to Landauer's rule (1930: 80) for asymmetry of individual feather patterns in domestic fowl in which the

larger pigment area of asymmetrically marked feathers is toward the main axis of the body and in which the left body side is the mirror image of the right one.

A system of deposition of melanin within a feather is suggested by these various patterns, and this may be indicated by Figure 3, in which progressive stages are shown by the letters a to e, and the direction of pigmentation by arrows. It is suggested that this apparent progressive pattern of pigmentation has some relation to pigmental invasion of a

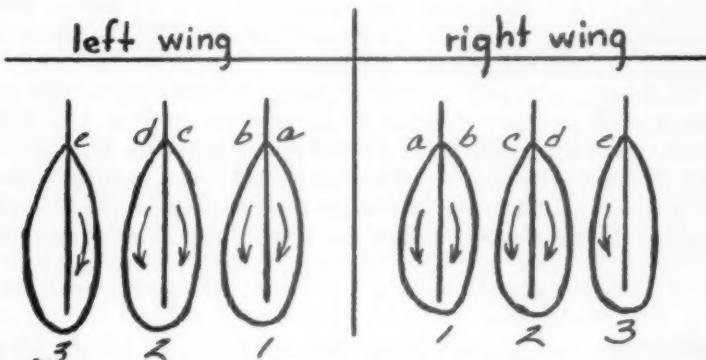


Figure 3. Apparent progressive development of pigmentation within proximal wing coverts.

feather, although depigmentation of black feathers (which happens in a sense when immature males acquire their first adult plumage) could be equally the case. Since black color appears to be a primitive character in the Icteridae (Beecher, 1950), the latter may well be the case, in which instance the arrows and letters in Figure 3 can simply be traced in reverse to indicate the gradual loss or present tendency toward reduction of black color.

Comparison of 97 adult male redwings collected at Regina (above) with 97 collected at Madison, Wisconsin, showed a distinct difference in extent of pigmentation of these feathers. The innermost feather was all black in 36 per cent of the Madison and in 56 per cent of the Regina birds. Furthermore, in the Regina birds, 44 out of 55 that had the first feather all black showed some black in the next feather, whereas in the Madison birds only three out of 35 in which the first feather was all black had some black on the second feather. These data suggest that the extent of black color on the middle wing coverts of the redwing

may have significance at the subspecific level generally, and also the possibility of a cline, particularly in view of the appearance of a western race in which this character appears to have reached its maximum extent (*A. p. californicus*). In this race black middle coverts, or at least broad black tips on the coverts, are a diagnostic trait (Ridgway, 1902: 326-330), and in a supposed Mexican race, *A. gubernator grandis* (Nelson), the middle coverts sometimes show "black only on tips of innermost coverts" (Ridgway, *ibid.*). The specimens from Regina have been considered to be *A. p. arctolegus* according to Snyder and Lapworth (1953), while those from Madison are *A. p. phoeniceus*, with tendencies toward *arctolegus* (Beer and Tibbitts, 1950). It would be desirable to check this trait in other races.

A number of tests were made in an attempt to determine whether the pattern of pigmentation remained similar from year to year in an individual. On 5 September 1952 I plucked and preserved the first (proximal) middle coverts of three captive adult males. One male had feathers that were all black—on 12 October these had regrown as all black feathers and were again plucked and saved. On 23 November the

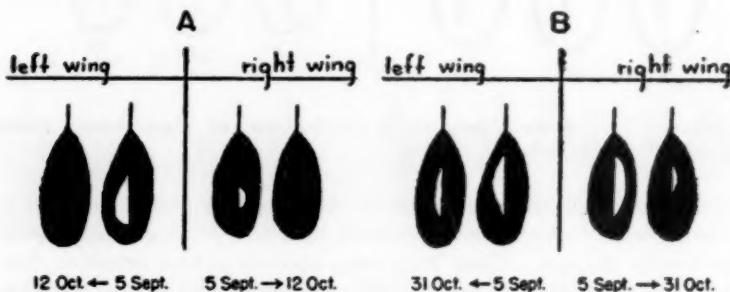


Figure 4. Actual patterns of successive feathers produced by forced molt in captive birds (innermost covert).

regrown feathers were again all black. The second bird had feathers that were incompletely pigmented and asymmetrical, with a light central area on the lateral web (see Figure 4, A). On 12 October these had regrown as all black feathers. The third bird had feathers that were all black on the median webs and on the outer edge of the lateral webs (Figure 4, B). On 31 October one feather had regrown to a similar pattern; the other was nearly all black. It is interesting to note that the tendency in these experiments was for an increased amount of black color following successive forced molts.

EXPERIMENTS ON THE DEGREE OF RED PIGMENTATION OF THE WING COVERTS

It is well known that the amount of red color in the wing coverts or "epaulets" of the redwing varies between adult individuals, and is especially variable and much reduced in juveniles and immatures (Dwight, 1900; Allen, 1914; Wright and Wright, 1944). The immature male attains the full red epaulets of the adult (as well as the rest of the plumage) late in its second summer. This change occurs with the postnuptial molt in late July and August (Dwight, *op. cit.*), at a time when gonadal activity is at a minimum (Wright and Wright, *op. cit.*). This suggests that sex hormones are not the responsible agents for regulation of red pigmentation. Some brief experiments which I made in 1949 and 1952-1953 (at the University of Wisconsin Zoology Department) may be of interest in this connection.

The effects of forced feather replacement by plucking castration, and the administration of testosterone propionate were tested on captive males with the following results. The normal dull orange-brown epaulets of an immature male were plucked following castration on 3 May 1949; the feathers soon regrew as a paler deep brownish-orange, showing a lower level of red pigment. Subcutaneous administration of a pellet of male hormone showed no effect on the next regrowth of feathers plucked from the opposite wing on 7 June; these grew in with much the same color as the previous forced feathers.

Similar results were observed in an adult male. Following the plucking of normal scarlet epaulets and castration on 3 May, epaulets regrew that were orange in color. Male hormone was administered, the other epaulets were plucked on 7 June, and again the renewed feathers were a shade of orange and much paler than normal. Quite similar results were obtained with a normal adult control bird: scarlet epaulets plucked on 22 May regrew as orange to orange-brown; epaulets plucked again on 7 June regrew generally as orange. However, epaulets plucked from a castrate adult male on 6 April regrew (by July) with more red pigment apparent, although below normal level, than in any of the others. Although there is no way of evaluating the dietary effect upon these caged birds, the above evidence would seem to suggest further that the male hormone, at any rate, is not the active agent regulating production of red pigment in this species.

During the period from March 1952 to April 1953, a number of additional trials were made on birds in captivity in order to determine whether the time of year might show some influence on the production of red pigment in the epaulets. Males were kept in captivity for up to

eight months and were maintained as usual on a standard poultry "scratch-feed" diet. Epaulets were plucked to force regrowth of feathers throughout this period, and in general results were as above; the feathers that regrew tended to be much less red than normal, and subsequent pluckings on the same bird yielded progressively paler plumage, so that a male that had normal scarlet epaulets when captured in July would by March bear feathers that were almost yellow in color (and frequently spotted with black). However, in one case feathers that regrew following plucking on 5 September were more red than those that regrew following plucking on the previous 18 April. In three birds that were allowed to go through a normal molt (in late July-August), the new epaulets were much less red than originally but were definitely above the level obtained by forced molts before and after this period. This may mean merely that the normal molting process permits greater production of red in the feathers, or it may mean that there is a physiological mechanism geared to the normal molting season. The highly variable epaulet plumage that is assumed by immature males in their first winter molt in late summer (varying from yellow to reddish-orange) may be related to such a cause. Inasmuch as carotenoid pigments (which produce the yellow and red color in the feathers) are available to birds mainly through plants (Fox, 1953), selection of food during the time of the molt may also influence the production of red in these feathers.

ACKNOWLEDGMENTS

I wish to thank the following persons for assistance with various aspects of this study: Professor John T. Emlen, Jr., who kindly read the manuscript, Dr. Fred Greeley, Richard A. Hunt, Professor R. K. Meyer, Dr. W. H. McShan, Professor J. C. Neess, and Dr. L. M. Van Horn.

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SEASONAL VARIATION IN THE ENERGY BALANCE OF THE TREE SPARROW IN RELATION TO MIGRATION*

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THE present distribution of birds implies favorable adaptation to specific niches. Permanent residents are adjusted to changing seasonal conditions in a single locality, while migrant species are adjusted to winter and summer environments in different localities. Migratory birds may attain a more nearly uniform environment than if they were to stay in one locality throughout the year. Studies on the House Sparrow, *Passer domesticus* (Kendeigh, 1949; Seibert, 1949; Davis, 1955), have shown how a resident species adjusts to seasonal changes in temperature and photoperiod. Seibert (1949) emphasized the importance of photoperiod, because he believed that migratory birds cannot metabolize energy at a rate sufficient to tolerate the low, northern, winter temperatures on the short photoperiods. Lincoln (1950) suggested that birds migrate north in the spring primarily to avoid over-crowded conditions in the south; but such migrants also would secure longer photoperiods in the north and avoid the extreme high temperatures of southern latitudes. Since Tree Sparrows, *Spizella arborea*, have been successfully kept outdoors throughout the summer in Illinois, several hundred miles south of their breeding range (Weise, 1956), an investigation was undertaken to trace the annual cycle of certain physiological changes in this species to determine whether migration is necessary to maintain a favorable energy condition throughout the year.

METHODS

Effect of Constant Temperature

To establish rates of energy intake at different temperatures and photoperiods, experiments under constant conditions were carried out in Champaign, Illinois, during 1956-1959 inclusive, and at Fort Churchill, in northern Manitoba, during the summers of 1956 and 1957.

Illinois birds were caught from large flocks with traps or mist nets from November through March. Churchill birds were trapped on their nests from 28 June to 17 July at the height of the nesting season. Sex was determined by autopsy at the end of the experiments. Birds

* Based in part on a doctoral dissertation in the Department of Zoology, University of Illinois, Urbana, Illinois.

captured during the first winter were placed in large cages or in large aviaries. There was a 50 per cent mortality within the first two weeks, apparently due either to the inability of some birds to locate food or to the less-aggressive birds being kept from food by their more-dominant cagemates. All birds captured later were placed in small, individual experimental cages measuring 6 x 10 x 10 inches and made of one-half-inch-mesh hardware cloth. Mortality decreased to 27 per cent. Once they were adjusted to captivity and food, birds not currently being used in experiments could be transferred, in groups of four, into the large cages outdoors, with only occasional mortality.

Methods of measuring food consumption and excrement loss, initiated by Kendeigh (1949) and subsequently employed by Seibert (1949) and Davis (1955), were followed. Metabolized energy was obtained by subtracting the caloric energy of the excreta from that of food consumption (*gross energy intake*). This difference represents *existence energy*, when birds maintain constant weight and the only energy demands are for standard metabolism, chemical heat regulation, specific dynamic action of food assimilation, and the securing of food and water. *Productive energy* is the energy metabolized beyond that required for existence. The potential productive energy at each temperature may be calculated by subtracting existence energy from the maximum amount of energy that can be metabolized at that temperature.

Coarsely ground food, University of Illinois baby chick mash No. 521, used by previous investigators and in the present study, was ground in a mill so that all particles would pass through one-sixteenth-inch-mesh window screening. Reduction in particle size facilitated sorting of excrement from unused food and insured against selection by the birds of specific components in the mixture.

Prior to experimentation, birds were confined in individual experimental cages for from one week to 10 days. In addition, from three to five days were allowed for birds to adjust to experimental temperatures. Metabolic data were collected only in the periods that birds maintained relatively constant weight; fluctuations of as much as 0.5 grams were allowed, since eating or voiding before weighing could change the weight by that amount. In order to minimize diurnal differences in weight, birds were always weighed at the same time of the day.

Birds were weighed and checked for fat and molt condition every three to five days. Fat classes are adapted from Weise (1956):

Class 1	No visible fat.	No fat visible in the furcular depression or on the abdomen.
Class 2	Little fat.	Fat lining the furcular depression, none on the abdomen.
Class 3	Medium fat.	Fat filling the furcular depression, visible fat in the abdomen between the intestinal folds.
Class 4	Heavy fat.	Furcular depression bulging with fat; peritoneal fat filling in between the intestinal folds.
Class 5	Very heavy fat.	Furcular depression bulging with fat; abdominal region bulging with peritoneal and subcutaneous fat.

An index of molt was obtained by use of the following scale: 0-2, little molt; 3-6, moderate molt; 7-9, heavy molt; 10-25, very heavy molt. Sheathed feathers on the body were added to those on the cage floor to give the total molt value where one molt unit was assigned for each primary, secondary or retrix; one unit for every five trunk feathers; and one unit for every 10 small head, neck, or throat feathers.

The cages were cleaned at the end of each three- to five-day metabolic run. All remaining food and excrement were placed in a drying oven at 83° to 100° C for from three to six days. The dried food and excrement were emptied into the sieve of window screening. A light rubbing of the contents with the palm of the hand usually was sufficient to effect complete separation of food from excrement. Any persistent food particles in the sieve were removed by hand. The dry weights of food and excrement were recorded to the nearest hundredth gram on a triple-beam balance immediately after sorting. The sorting and weighing process lasted two minutes or less per sample, hence there was little or no resorption of moisture.

The caloric value for each 100-pound bag of food measured in a Parr adiabatic oxygen bomb calorimeter varied between 4.437 and 4.449 kcal. per gram dry weight. Moisture in the food varied from 10.2 to 16.6 per cent water. Values used in the calculations were those of the particular batch of food being used. The amount of food given the birds varied with the temperature from 50 grams wet weight at 39° C to 100 grams wet weight at -30° C for three-day intervals. Water was available ad libitum; snow or frost was provided at temperatures below freezing.

Three large cabinets, one small refrigerator unit, one kitchen refrigerator, and a specially constructed "hot box," all thermostatically controlled, provided the necessary range of temperatures. The first four units were utilized in Illinois, the latter two at Churchill. Humidity varied from 23 to 33 per cent in the high-temperature cabinet, from 73 to 85 per cent in the medium-temperature cabinet, from 70 to 87 per cent in the low-temperature cabinet, and from 74 to 76 per cent in the small refrigerator unit. The kitchen refrigerator had a high relative humidity; the "hot box" was extremely dry. No attempt was made to regulate

humidity, since the effect of air moisture on temperature regulation and metabolism is probably important only at much higher humidities at high temperatures (Salt, 1952; Wallgren, 1954).

Air movement in the medium-temperature cabinet was measured with an anemometer. Measurements taken with a probe inside the experimental cages averaged 21.3 feet per minute. No corrections have been made for the effect of air movement. There was no forced-air movement in the high- or low-temperature cabinets, and only a slight air flow in the small unit, kitchen refrigerator, and "hot box."

Light was regulated by automatic time switches to correspond with the amount of time birds were observed to be active. Birds at Churchill were active for 19 hours each day during June (2:30 A.M. to 9:30 P.M.), but the time between sunrise and sunset is only 18.01 hours. Astronomical twilight lasts 5:31 hours. Hence birds are active for only one hour or 18.2 per cent of the astronomical twilight period (approximately 67 per cent of civil twilight). Assuming that the same relative amount of the astronomical twilight period is utilized in all months, the effective photoperiod consists of the average number of hours between sunrise and sunset per month plus 18.2 per cent of the monthly mean astronomical twilight period. Therefore, the 10-hour photoperiod, regulated from 7 A.M. to 5 P.M., corresponds with the minimum effective winter photoperiod in Illinois. Fifteen-hour photoperiod (6 A.M. to 11 P.M.) represents the average effective summer photoperiod in Illinois, 19-hour photoperiod (2:30 A.M. to 9:30 P.M.), the maximum effective summer photoperiod at Churchill.

Birds were only rarely shifted from one photoperiod to another, and in these cases, the photoperiod was changed gradually over at least three days. The amount of light varied from 65 lux (6.0 foot-candles) in the high-temperature cabinet to 74 lux (6.8 foot-candles) in the small unit, 110 lux (10.2 foot-candles) in the medium-temperature cabinet and 112 lux (10.3 foot-candles) in the low-temperature cabinet. The kitchen refrigerator contained one 100-watt incandescent bulb; the "hot box" had two 40-watt fluorescent lamps.

Burger (1949) states that 10 foot-candles (108 lux) is sufficient light for normal winter sperm production in House Sparrows. It is well known that birds may be normally active under natural conditions at much lower intensities. Light measurements were made with a Weston Illumination Meter model No. 603, using a viscor filter that records the various wave lengths in proportion to the reception of the human and probably also bird eye (Walls, 1942: 497-504).

Effect of Fluctuating Temperatures

As a control for constant condition experiments, 36 birds were kept outdoors for varying lengths of time in Illinois and at Churchill. Birds were placed in small, individual experimental cages, provided with food and drink, and in all ways treated like the birds under constant conditions. Birds were weighed, checked for molt and fat, the cages cleaned, and metabolism measured every three to six days from February to

August 1956, and February to April 1958, in Illinois, and during late July and August of 1956, and August 1957, in Churchill.

Illinois birds were kept in an aviary protected from precipitation and except in the early morning hours shielded from direct sunlight. The cages were partially protected from the wind by the walls of a building on the north and west and by vines that covered the aviary in the summer. All temperatures were obtained in summary form from the Urbana weather station, located about 100 yards from the aviary.

During the summer of 1956, Churchill birds were kept on a shelf in an otherwise abandoned building, 12 x 18 x 10 feet. Windows on all sides were fitted with screens; but due to high winds, it was necessary to cover many of the windows on the north, east, and west sides with translucent plastic screening. Daily temperatures were recorded with a maximum-minimum thermometer and averaged slightly higher than at the Fort Churchill weather station, about one-quarter mile distant. In 1957, a wooden shelter, 6 x 4 x 6 feet, was constructed on the roof of the Defence Research Northern Laboratory building. Birds were kept on a shelf and protected on all sides but the south. An overhanging roof prevented rain from entering the cages. Temperatures recorded with a maximum-minimum thermometer did not differ from those at the weather station.

Air temperature fluctuated from -14° to $+26^{\circ}$ C during the course of the measurements in Illinois. The photoperiod rose from 11:12 in February to a maximum of 15:39 in June, then fell to 14:23 in August.

Statistical procedures are taken from Ostle (1954) and Snedecor (1956). Unless otherwise indicated, a probability level of 0.01 was required for comparisons to be considered significant.

RESULTS

Effect of Constant Temperature

Weight. Body weights declined after capture, but increased to their original level before experimentation. There were no significant differences in weights of experimental birds one to three weeks before starting their first experimental run and average monthly weights of birds shot in the field and weighed a few hours after death (Table 1). Due to the large individual variation in minimal weight, minor variations in average weight and fat classes from temperature to temperature or between photoperiods are not significant (Table 2). Minimal weight is the lowest, not the average, body weight that a bird maintained for at least two days while at a fat class of 1.

TABLE 1

WEIGHTS OF TREE SPARROWS CAPTURED ALIVE AND WEIGHED ONE TO THREE WEEKS BEFORE EXPERIMENTATION COMPARED WITH WEIGHTS AND FAT CLASSES OF WILD BIRDS THAT WERE SHOT

Month	Sex	No. of birds	Captured		Sex	No. of birds	Shot Av. wt. (gms.)	Av. fat class
			Av. wt. (gms.)					
Nov.	M	4	19.2		M	7	17.8	
	F	1	18.2		F	7	16.8	
	M+F	5	18.9		M+F	14	17.3	2.9
Dec.	M	3	19.3		M	10	19.2	
	F	3	17.3		F	7	17.7	
	M+F	6	18.3		M+F	17	18.6	2.8
Jan.	M	9	19.4		M	5	19.5	
	F	5	17.4		F	4	18.3	
	M+F	16	18.6		M+F	9	18.9	3.3
Feb.	M	11	19.2		M	16	20.1	
	F	11	17.9		F	10	18.8	
	M+F	23	18.5		M+F	26	19.6	3.8
Mar.	M	1	20.6		M	9	19.6	
	F	—	—		F	4	19.3	
	M+F	1	20.6		M+F	13	19.5	3.6
June	M	—	—		M	19	18.7	
	F	1	17.7		F	20	19.3	
	M+F	1	17.7		M+F	39	18.9	2.9
July	M	7	16.7		M	14	18.6	
	F	9	17.9		F	3	17.2	
	M+F	16	17.4		M+F	17	18.4	2.1
Aug.	M	—	—		M	4	18.7	
	F	—	—		F	1	15.5	
	M+F	—	—		M+F	5	18.1	1.6

Summer birds kept in captivity in Illinois were fatter than either winter birds or summer birds at Churchill. Experiments in 1958 at 15 and 19 hours in Illinois were carried out during the summer, and therefore these two photoperiods had birds of higher weights than did the 10-hour winter group (Table 2). All 1959 birds were placed at 10 hours and -4° C immediately upon capture in December. Experiments were conducted from January to May.

As temperature was lowered toward -30° C , fat decreased slowly until a minimum fat class of 1 was reached at the lowest temperature (Tables 2 and 3). Because birds with heavier minimal weights were by chance used at lower temperatures, the mean experimental weights did not decline as would be expected. However, the per cent difference between the average minimal weight and the average experimental

TABLE 2

BODY WEIGHTS, FAT CLASSES AND MOLT VALUES OF TREE SPARROWS
UNDER CONSTANT CONDITIONS

Temp. (° C)	No. birds	Minimal wt. gms. ± S.E.	Av. wt. gms. ± S.E.	Per cent diff.	Fat class	Molt units
10-hour photoperiod (1956-1958)						
(1959)						
-29.6	4	17.2 ± 0.46	18.5 ± 0.69	7.0	1.0	0.5
-24.2	5	16.8 ± 0.30	17.9 ± 0.53	6.1	1.0	0.8
-22.0	10	16.8 ± 0.44	18.5 ± 0.51	9.2	1.6	0.1
-15.0	12	17.0 ± 0.39	18.7 ± 0.40	9.1	1.6	0
-4.0	12	17.2 ± 0.29	18.8 ± 0.43	8.5	2.8	0
+4.0	11	16.7 ± 0.34	18.7 ± 0.54	10.7	1.6	0
+18.7	3	16.8	19.0 ± 0.95	11.6	—	—
+30.0	11	16.0 ± 0.31	18.9 ± 0.48	15.3	2.2	0.4
+35.0	6	15.5 ± 0.31	18.8 ± 0.59	17.6	3.2	0
+37.0	7	15.3 ± 0.33	17.3 ± 0.57	11.6	2.9	0
+38.0	6	15.5 ± 0.31	16.4 ± 0.37	5.5	2.6	0.3
+39.0	6	15.5 ± 0.31	15.8 ± 0.34	1.9	2.2	0.3
15-hour photoperiod (1956-1958)						
-4.0	10	—	18.5 ± 0.39	—	1.9	0
(1959)						
-27.6	7	16.2 ± 0.35	19.1 ± 0.74	15.2	1.7	0
-15.0	9	16.8 ± 0.37	20.7 ± 0.71	18.8	3.0	0
+4.0	11	17.2 ± 0.17	19.9 ± 0.50	13.6	3.0	0.1
+30.0	8	17.4 ± 0.19	21.1 ± 0.74	17.5	4.1	0.1
+37.0	6	15.5 ± 0.31	16.9 ± 0.49	8.3	3.7	0.1
+39.5	6	15.5 ± 0.31	16.1 ± 0.52	3.7	3.4	0.9
(1959)						
-4.0	10	—	18.7 ± 0.39	—	2.8	0
-4.0	6	—	17.8 ± 0.68	—	1.4	20.8
19-hour photoperiod (Illinois) (1956-1958)						
-29.0	4	17.2 ± 0.19	19.3 ± 0.43	10.9	1.0	0.8
-25.0	3	17.9 ± 0.45	18.6 ± 1.34	9.1	1.5	0
-15.0	11	17.1 ± 0.17	19.0 ± 0.60	10.0	1.6	0
+8.0	8	16.7 ± 0.43	20.1 ± 0.74	16.9	3.2	0.3
+30.0	10	16.6 ± 0.35	22.1 ± 0.71	24.9	4.9	0.1
(1959)						
-4.0	10	—	20.2 ± 0.74	—	1.2	0
-4.0	9	—	18.0 ± 0.63	—	2.0	4.9
19-hour photoperiod (Churchill) (1956-1957)						
+7.8	13	15.8 ± 0.29	18.3 ± 0.34	13.7	1.1	5.1
+32.1	13	15.8 ± 0.29	17.2 ± 0.35	8.1	1.1	3.3

TABLE 3

FAT CLASSES OF INDIVIDUAL TREE SPARROWS MAINTAINED INDOORS
AT DIFFERENT CONSTANT TEMPERATURES

Temp. (° C)	04054		04074		Band number of bird		04050	04066
					04045	04056		
-30	1 (Mar.)*	1 (Mar.)		1 (Feb.)	—	—	—	—
-24	1 (Mar.)	1 (Mar.)		—	—	—	—	—
-22	1 (Feb.)	1 (Mar.)		—	2 (Mar.)	2 (Mar.)	—	—
-15	2 (Feb.)	—	2 (Jan.)	2 (Jan.)	2 (Feb.)	1 (Jan.)	—	—
-4	—	2 (Feb.)	3 (Dec.)	—	—	—	—	—
+4	2 (Jan.)	—	2 (Dec.)	2 (Jan.)	—	—	—	—
+8	—	5 (June)	4 (June)	4 (June)	2 (June)	3 (June)	—	—
+30	—	—	5 (May)	5 (May)	3 (May)	5 (May)	—	—
+35	—	—	—	—	—	—	4 (Feb.)	—
+37	—	—	—	—	—	1	—	3 (Mar.)
+38	—	—	—	—	—	—	—	3 (Mar.)
+39	—	—	—	—	—	—	—	3 (Apr.)

* Month of observation.

weight of birds at 10 and 19 hours decreased at lower temperatures (Table 4). Because vernally fattened birds were brought in from outdoors and placed immediately at low temperatures, this decrease did not occur at 15 hours.

Although male Tree Sparrows weigh more than females (Table 1), their energy requirements showed no significant differences. Therefore, all data for both sexes are combined in the following analyses.

Heavier birds require more energy than lighter at temperatures from -15° to -30° C, but not at 30° C (Table 4). This is apparently due to the added adipose tissue in heavier birds, since at -15° and -25° to -30° C there is a significant increase in metabolism and no significant difference in minimal weights. Odum and Perkinson (1951) have also shown that in White-throated Sparrows, *Zonotrichia albicollis*, lean weights remained approximately the same at all seasons, and seasonal changes in weight were the result of fat deposition and utilization. The metabolism of adipose tissue (exclusive of brown fat) is considerably below that of other body tissues (Shapiro and Wirtheimer, 1956); thus the extra energy utilization of heavier birds appears to be correlated with the added amount of fat.

The calories metabolized per gram mean body weight were not significantly different within each temperature range (Table 4). Therefore, expression of energy values in terms of the whole bird is justified only when the bird's average experimental weights are approximately the same at each temperature condition.

TABLE 4
RELATION OF BODY WEIGHT TO METABOLISM OF TREE SPARROWS
UNDER CONSTANT CONDITIONS

Av. exp. wt.	No. of birds	Minimal wt. (gms.) mean \pm S.E.	kcal./bird/day		Metabolized energy kcal./gm. av. wt./day \pm S.E.
			\pm S.E.	P	
-25° to $-30^{\circ}C$	18.0	17	16.6 \pm 0.21	26.89 \pm 0.67 >0.001	1.50 \pm 0.05
	20.6	6	17.3 \pm 0.19	34.23 \pm 0.87 >0.001	1.64 \pm 0.04 >0.2
$-15^{\circ}C$	16.4	4	15.6 \pm 0.48	22.38 \pm 0.99	1.36 \pm 0.06
	18.9	21	17.2 \pm 0.23	25.49 \pm 0.58 >0.05	1.35 \pm 0.04 >0.9
	22.2	7	16.9 \pm 0.26	28.53 \pm 0.86 >0.05	1.28 \pm 0.02 >0.3
$+30^{\circ}C$	18.4	17	16.1 \pm 0.27	10.77 \pm 0.32 >0.5	0.57 \pm 0.02 >0.2
	23.0	12	17.2 \pm 0.18	11.28 \pm 0.55 >0.5	0.49 \pm 0.03 >0.2

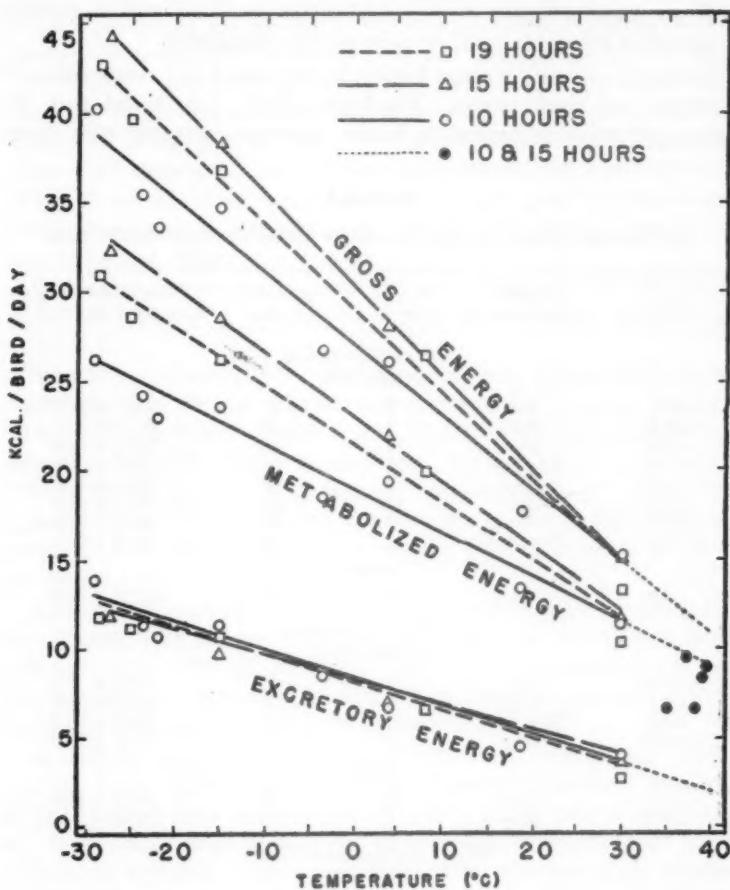


Figure 1. Energy balance of Tree Sparrows at 10-, 15- and 19-hour photoperiods under constant conditions. The following formulae apply: gross energy in kcal./bird/day: 10 hours, $28.73 - 0.406T^{\circ}\text{ C}$; 15 hours, $30.19 - 0.507T^{\circ}\text{ C}$; 19 hours, $28.68 - 0.428T^{\circ}\text{ C}$. Excretory energy: 10 hours, $8.02 - 0.159T^{\circ}\text{ C}$; 15 hours, $7.62 - 0.141T^{\circ}\text{ C}$; 19 hours, $7.61 - 0.152T^{\circ}\text{ C}$. Metabolized energy: 10 hours, $18.57 - 0.247T^{\circ}\text{ C}$; 15 hours, $22.57 - 0.366T^{\circ}\text{ C}$; 19 hours, $21.07 - 0.330T^{\circ}\text{ C}$. Lines between 30° and 39.5° C are extensions of regression lines for the 10-hour photoperiod.

Gross energy intake. Like earlier investigators (Kleiber and Dougherty, 1934; Kendeigh, 1949; Seibert, 1949; Davis, 1955; Steen,

1957), I found (Figure 1) that food intake increases with decreasing temperature below the point or zone of thermoneutrality.

Excretory energy. Energy lost in the excrement is a combination of intestinal and renal wastes. Kendeigh (1949: 118) found that the energy per gram excrement in House Sparrows increased with lower

TABLE 5
METABOLIZED ENERGY OF TREE SPARROWS UNDER CONSTANT CONDITIONS

Temp. (° C)	Month of experiment	No. of birds	Total days feeding	Metabolized energy kcal./bird/day ± S.E.
10-hour photoperiod (1956-1958)				
-29.6	Mar.	4	21	26.22 ± 1.07
-24.2	Mar.	5	17	24.19 ± 0.69
-22.0	Mar.	10	60	22.91 ± 0.36
-15.0	Jan., Feb.	12	91	23.55 ± 0.74
-4.0	Dec.	12	80	18.52 ± 0.95
+4.0	Dec.	11	112	19.33 ± 0.80
+18.7	Apr.	3	39	13.12 ± 1.10
+30.0	Dec., Feb.	11	90	11.14 ± 0.50
(1959)				
-4.0	Jan.	10	90	18.58 ± 0.29
15-hour photoperiod (1956-1958)				
-27.6	July	7	49	32.59 ± 1.30
-15.0	July	9	93	28.35 ± 0.55
+4.0	May, June	11	107	20.84 ± 0.60
+30.0	May	8	77	11.67 ± 0.35
(1959)				
-4.0	Jan.	10	90	20.46 ± 0.59
-4.0	May	6	54	24.55 ± 0.75
19-hour photoperiod (Illinois) (1956-1958)				
-29.0	June	4	29	30.79 ± 1.33
-25.0	June	3	12	28.49 ± 1.85
-15.0	May	11	93	26.13 ± 0.66
+8.0	June	8	76	19.94 ± 0.36
+30.0	May	10	92	10.25 ± 0.53
(1959)				
-4.0	Apr.	10	90	23.59 ± 0.34
-4.0	May	9	81	24.88 ± 0.73
19-hour photoperiod (Churchill) (1956-1957)				
+7.8	July, Aug.	13	133	21.01 ± 1.38
+32.1	July, Aug.	13	113	13.11 ± 0.48

temperatures. Seibert (1949: 135) showed that the least amount of energy per gram excrement in the Junco, *Junco hyemalis*, White-throated Sparrow, and House Sparrow was produced at 22° C. Davis (1955: 393), however, concluded that, in 46 House Sparrows, there was "no direct relationship between temperature and per gram fecal energy." In the present study, involving 136 calorimetric determinations of 59 birds at 10- and 19-hour photoperiods and from -29.6° to +39° C, no significant variation of calories per gram excrement with temperature could be demonstrated. The average of all determinations was 3.735 kcal./gram.

Decreasing temperature caused increased energy loss in the excrement, but there were no significant differences between photoperiods (Figure 1).

Metabolized energy. The differences between photoperiods in the regression lines for the daily amount of metabolized energy were not statistically significant (Table 5 and Figure 1). Metabolized energy values at Churchill (Table 5) were high, since the birds were in molt (Table 2) and probably had moderate nocturnal activity. Other Tree Sparrows kept outdoors during the time the constant-temperature experiments were run showed nightly activity of three intervals out of 20 per hour for the five-hour night.

Efficiency of food utilization. The Tree Sparrow shows a steady rise in efficiency with temperature, best expressed with the 10-hour birds (65 per cent at -28°, 77 per cent at +37° C). The percentage of food digested likewise increases from short to long photoperiods (at 19 hours: 72 per cent at -29° C, 79 per cent at +35° C).

In studying winter-acclimated House Sparrows, both Seibert (1949) and Kendeigh (1949) showed steady increases in efficiency from low to high temperatures (84 per cent at -31°, 92 per cent at +34° C), and the 15-hour birds were more efficient than 10-hour birds. Davis (1955), in studying summer-acclimated birds, discovered an increase in efficiency only up to 18° C and a sudden drop above this (75 per cent at 0°, 88 per cent at 18°, 74 per cent at 26° C). Again the 15-hour birds were more efficient than the 10-hour group. He (p. 395) explained that this 18° C temperature approximated the environmental temperature (19.4° C) from May through October to which the birds were naturally adapted.

Tolerance of low temperature. The limit of tolerance to low temperature (when only 50 per cent of the birds were able to survive and maintain constant weights for a period of nine days) was determined for Tree Sparrows in Illinois. This limit for 10-hour winter birds (4

out of 9 survived) was -28° C; for summer birds -27.6° (5 out of 10) on 15-hour photoperiods and -25° C (3 out of 6) on 19-hour photoperiods. The statistically insignificant reduction in tolerance of the 19-hour birds is correlated with molt taking place at the time. Apparently, the heat released with nightly activity in the 15- and 19-hour birds did not extend the lower limit of temperature tolerance. There is no appreciable seasonal change in ability to tolerate low temperatures; the lower limit for the species lies near -28° C. These results are quite different from those for the permanent resident House Sparrow, where the lower limit of tolerance of -31° C in winter decreases to 0° C in the summer (Davis, 1955).

TABLE 6

METABOLISM OF TREE SPARROWS AT HIGH CONSTANT TEMPERATURES DURING FEBRUARY AND MARCH (37° C REPRESENTS AVERAGES OF 10- AND 15-HOUR PHOTOPERIOD, 30° , 35° , 38° , 39° ARE 10 HOURS, 39.5° C IS 15 HOURS)

Temp. ($^{\circ}$ C)	No. birds	Gross energy kcal./bird/day \pm S.E.	Excretory energy kcal./bird/day \pm S.E.	Metabolized energy kcal./bird/day \pm S.E.
30.0	11	15.18 \pm 0.65	4.03 \pm 0.22	11.14 \pm 0.50
35.0	6	9.06 \pm 0.60	2.30 \pm 0.22	6.76 \pm 0.40
37.0	7	12.25 \pm 0.50	2.96 \pm 0.03	9.29 \pm 0.42
38.0	6	8.78 \pm 0.45	2.07 \pm 0.15	6.72 \pm 0.31
39.0	6	10.95 \pm 0.70	2.57 \pm 0.13	8.39 \pm 0.54
39.5	6	12.04 \pm 0.56	3.12 \pm 0.19	8.92 \pm 0.43

Experiments at high air temperatures. Exploratory experiments at high air temperatures, 35° to 39.5° C on 10- and 15-hour photoperiods, were run in order to determine upper lethal limits for Tree Sparrows. The same six birds were used in all experiments; one additional bird was used at 10 hours and 37° C. Although the birds used at high temperatures by chance had lower minimal weights, fat values and weights declined at high temperatures (Table 2). Molt did not increase but remained between 0 and 0.9 units at all temperatures.

Metabolism decreased abruptly between 30° and 35° C and then fluctuated to 39.5° C (Table 6 and Figure 1). Although a thermo-neutral zone was not demonstrated, the critical temperature is assumed to be in the vicinity of 40° C.

Upper limits of tolerance were not determined. However, when the temperature in the cabinet accidentally rose to 45° C for about two

hours, all five of the remaining birds survived the temperature shock. The following day the temperature rose to 47° C for one hour. Four birds were in heat shock; their breathing rates averaged 300/minute, even after the temperature in the cabinet had dropped to 40° C. These birds died, although they had been placed while alive at room temperature and given water. Weights taken immediately after death averaged 14.1 grams (1.1 grams below average minimal weights), indicating excessive water loss.

Effect of Fluctuating Temperature

Gross energy. Gross energy (G.E.) intake decreased linearly with increasing temperature (G.E. = 25.89 kcal./bird/day — 0.254T° C). The slope of the line is not as steep as the gross energy line under constant temperature conditions. The two lines cross at about 9° C and diverge to become significantly different at both high and low temperatures (West, 1958).

Excretory energy (E.E.) Energy lost in the excrement decreased linearly with increasing temperature (E.E. = 6.84 kcal./bird/day — 0.088T° C). The rate is less than under constant conditions, but the difference is not significant. The food-utilization efficiency of outdoor birds is the same as that of birds under constant conditions on 19- and 15-hour photoperiods, and above that of 10-hour birds except at —4° C (West, 1958).

Metabolized energy. Metabolized energy (M.E.) decreased with increasing temperature (M.E. = 19.05 kcal./bird/day — 0.167T° C). The line for fluctuating temperature crosses the line for constant temperature at —4° C and then diverges at high and low temperatures, where the two lines are significantly different (West, 1958). Davis (1955) found that House Sparrows outdoors in the summer metabolize almost the same amount at all temperatures, with only a slight slope indicated. The metabolic rate is higher than would be expected with change from low to high temperatures and lower than expected with change in the reverse direction. The flatter slopes of birds under fluctuating conditions are as yet unexplained.

Birds kept outdoors at Churchill during late July and August showed considerable variation in metabolism in the temperature range from 10° to 22° C. As with Illinois birds, energy metabolism decreased with increasing temperature, but only the regression of gross energy intake was significant. The lack of significant changes in metabolized energy with temperature may be explained by variations in intensity of the

postnuptial molt during August and in the amount of insulation furnished by the plumage.

Plumage weight. Feathers were weighed to determine if temperature had any effect on the density of the plumage. Summer Tree Sparrows collected in Churchill had 25 per cent lower plumage weights than Illinois winter birds, but birds retained in Illinois during the summer lost only 6 per cent of their heavier winter plumage (West, 1958). Kendeigh (1934) has shown that House Sparrows decrease the weight of their plumage by 29 per cent from the previous autumn to summer. These observations indicate that either differences occur in plumage wear or that wild birds molt more extensively in the spring than do caged birds. According to Dwight (1900), Weise (1956), and the present study, only a partial spring molt, involving the head and neck, occurs; but Baumgartner (1938) records a more extensive molt in birds shot in the spring at Ithaca, New York.

There is no significant difference in the plumage weights of Illinois winter birds maintained above 35° C and below -15° C , nor are there any differences between the plumage weights of either group and those of the outdoor winter controls (West, 1958).

DISCUSSION

It was originally supposed (Kendeigh, 1949) that the maximum metabolized energy value occurring at the lowest tolerated temperature could also be attained at higher air temperatures under other energy-demanding stresses than heat regulation and that productive energy would increase as a straight line from zero at the lower limit of tolerance to a maximum at the zone of thermoneutrality. This concept needs to be modified for the Tree Sparrow.

Although the regression lines for metabolized energy are not statistically different, it was suspected that this might be due to nightly unrest in the 15- and 19-hour birds. No recordings of either daytime or nocturnal activity had been made. It is well known (Eyster, 1954) that migratory birds become active at night when the photoperiod is increased either experimentally or in nature as in the spring. Since the experimental birds had been caged outdoors from their capture in February until 1 May, their gonads had fully developed when they were moved inside on 15-hour photoperiods, and there is every reason to believe that their nightly unrest was strong. This is doubtless the reason why their metabolized energy was above that of the 10-hour birds at all temperatures (Kendeigh, West, and Cox, MS).

The intermediate values for metabolized energy of the 19-hour birds

are probably due to the shorter night period available for unrest. Birds were shifted back and forth between 15 and 19 hours, especially at the lower temperatures; therefore, they were probably active at both photoperiods.

At the lowest tolerated temperature (-28° C), birds that were presumably active at night on 15-hour photoperiods metabolized 32.82 kcal./bird/day, 7.34 kcal. more than those that were on 10-hour photoperiods, not active at night, and at an existence level at -28° C . This may still not be the maximum that the birds can metabolize at this temperature. The maximum energy utilization is at least as great as this at other temperatures, but, as yet, it has not been demonstrated that it could be greater for any extended period with the bird maintaining a constant weight.

In experiments at -4° C , birds that were active at night (44.0 units/night) metabolized 23.81 kcal./bird/day; birds that were molting heavily (20.8 units), 24.55 kcal.; and birds that were both somewhat active at night (1.8 units/night) and molting lightly (4.9 units) were able to metabolize 24.86 kcal./bird/day, an average of 5.86 kcal. more than those on an existence level at the same temperature. Again, these rates may not represent the maximum capability of the bird.

The ability to do work probably reaches a maximum at some temperature range between the lower limit of tolerance and the thermoneutral zone. In man, maximum work is possible between 4° and 18° C (Brody, 1945). In the House Wren, *Troglodytes aedon*, the largest eggs are produced at temperatures between 20° and 25° C (Kendeigh, 1941). The productivity of farm animals remains constant in environmental temperatures from the comfort zone (15° – 21° C) to perhaps -18° C , while above 27° C , productivity is reduced (Brody, 1945). Maximum work of laboratory white mice occurs between 20° and 30° C (Hart, 1950).

At high air temperatures, the ability to work decreases rapidly. Milk production in cattle, growth of baby chicks (Brody, 1945), and work ability of man (Bedford, 1952) decline with increasing temperature. At the upper end of the thermoneutral zone, the ability to carry on work even over short periods of time is presumably reduced to zero, since the body temperature would be raised toward the lethal level.

It is postulated that the amount of energy available for activities other than existence, rather than increasing as a straight line to the critical temperature, increases with increasing temperature from -28° C to about 20° – 25° C and then drops rapidly to zero at the critical temperature of about 40° C (Figure 2). Potential total energy intake appears

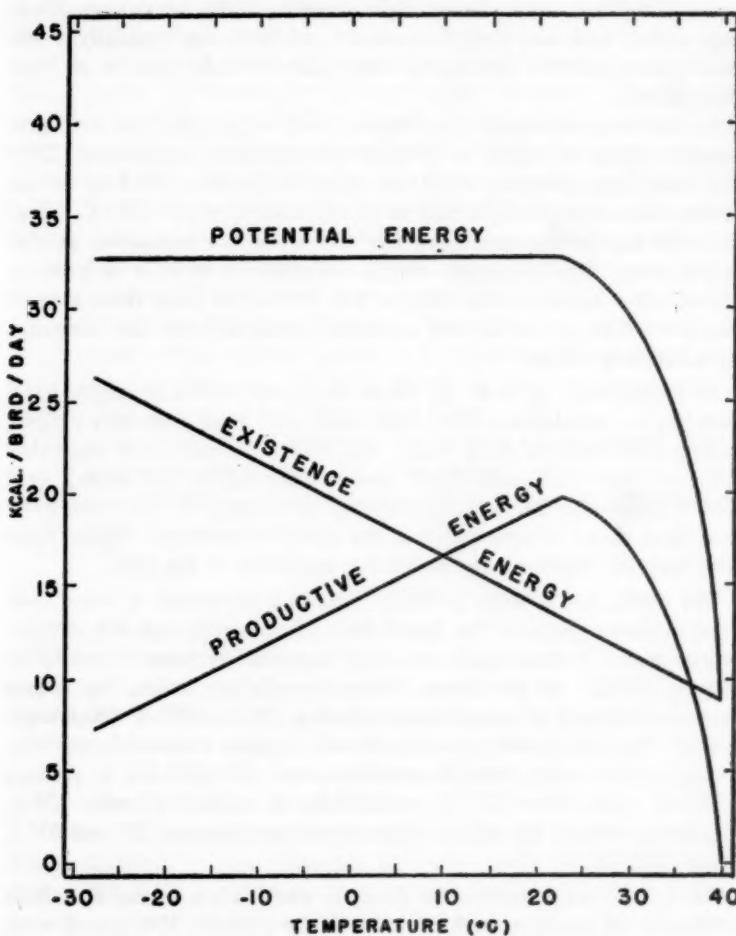


Figure 2. Potential, existence, and productive energy of Tree Sparrows. Potential energy is based on the assumption that at least the maximum amount of metabolized energy could be metabolized at any temperature from -28° to $20^{\circ}\text{--}25^{\circ}$ C.

to be a constant from -28° to about $20^{\circ}\text{--}25^{\circ}$ C; it decreases to the existence level at about 40° C (Figure 2).

Curves of existence energy throughout the year are constructed for the Tree Sparrow by substituting the mean temperatures of the appro-

priate months for Illinois and at Churchill in the formula for metabolized energy under constant conditions at 10-hour photoperiods ($18.57 \text{ kcal./bird/day} - 0.247T^\circ \text{ C}$, Figure 3). Since birds are migrating during April, May, September, and October, they do not experience the mean monthly temperature at either locality, and lines have been drawn at intermediate levels.

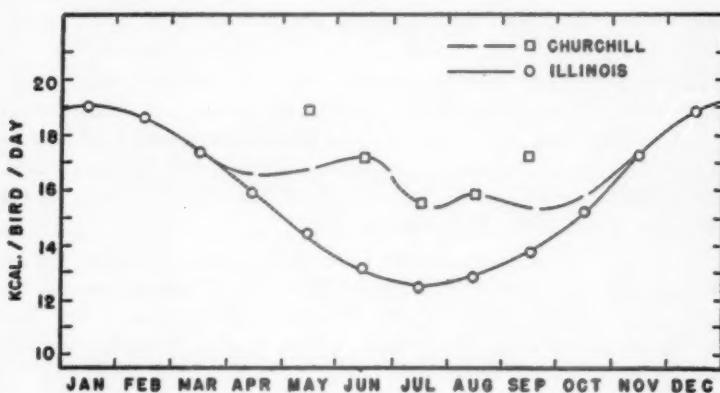


Figure 3. Existence energy requirements of Tree Sparrows throughout the year. The solid line represents requirements for birds spending the year in Champaign, Illinois; the broken line is for birds migrating to Churchill.

Due to the lower mean temperatures in summer, the daily existence energy requirements are greater at Churchill than they would be if birds remained in Illinois. However, the increased summer daylight in the north (19 compared with 15 hours in Illinois) cancels the effect of lower mean temperatures, so that the hourly rate at which existence energy must be accumulated is the same in both latitudes (0.85 kcal./bird/hour of daylight).

The following analyses of the amounts of energy required for activities other than existence, although preliminary and hypothetical, are made in order to form a more complete picture of the total annual energy needs of the Tree Sparrow.

From the first week in November when the Tree Sparrow arrives in Illinois until the middle of February, birds put on winter fat. The average weight of Tree Sparrows in November is 17.3 grams and in February 19.6 grams (Table 1). Assuming that the weight increase is

70 per cent fat (McGreal and Farner, 1956), this represents 15.21 kcal. of fat, an increase accumulated at the average rate of 0.17 kcal. per day. During March and early April, premigratory fat is deposited rapidly, so that in 30 days birds gain an average of 1.8 grams (Kendeigh, West, and Cox, MS). Since the per cent water content in storage fat decreases with increasing stores (McGreal and Farner, 1956), about 88 per cent of the weight gain is fat. This represents the accumulation of 14.97 kcal. of fat at the average rate of 0.50 kcal. per day.

At the same time, nightly unrest increases to its maximum. Birds at the peak of nocturnal activity metabolize 23.81 kcal./bird/day at -4° C. However, 18.55 kcal. is spent on existence, and 0.50 kcal. is deposited as fat. The cost of depositing one kcal. of fat is 1.67 kcal. beyond existence (Connell, 1959). The difference, 3.92 kcal., is the daily cost of maximal nightly unrest.

In preparation for each migratory flight, fat is deposited at an increasing rate until flight occurs, and then the fat stores are rapidly depleted (Wolfson, 1954). This pattern is repeated until the bird reaches its destination. The actual energy cost of a migratory flight was not obtained.

The energy required for reproductive activities in the summer may be estimated for the female during the incubation period. With the exception of the requirements for egg production, males and females probably have similar daily energy expenditures.

The average temperature of the eggs throughout the 24-hour day is 33.8° C in most songbirds (Huggins, 1941). The average body temperature of birds during the breeding season is 41.3° C (Baldwin and Kendeigh, 1932). There is thus a 7.5° C average difference between eggs and bird throughout the 24-hour period. Van't Hoff's law for biological functions states that the rate of a function increases two to three times with an increase of 10° C body temperature, Q_{10} (Heilbrunn, 1943). This has not been determined for the Tree Sparrow, but assuming an increase of 2.5 times/ 10° C, the increase would be 2.0 times for the 7.5° C difference between egg and body temperature. Or, inversely, a drop of 7.5° C would reduce the rate of metabolism to one-half.

Assuming that the energy necessary to maintain one gram of egg at incubation temperature is equal to maintaining one gram of bird at the same body temperature, the following equation applies:

$$\frac{\text{Existence energy} \quad (\text{kcal./bird/day}) \times \text{Total weight of eggs (grams)}}{\text{Bird wt. (grams)}} = \frac{1}{Q_{10}} = \text{Energy required for incubation (kcal./day)}$$

At Churchill, birds require an average of 16.15 kcal. per day for existence during the summer. The average body weight of birds in the summer is 18.7 grams (Table 1). Eggs weigh 2.12 grams each, and the average clutch size is 5 (Baumgartner, 1937).

Therefore:

$$\frac{16.15}{18.7} \times 5(2.12) = 4.58 \text{ kcal./day.}$$

In Illinois, with a mean summer temperature of 23.3° C, energy required for incubation would amount to only 3.63 kcal./day.

The complete postnuptial molt begins the first week in August and lasts into September. Caged Tree Sparrows undergoing a complete molt at -4° C metabolized 6.00 kcal./day above the existence level for over one week.

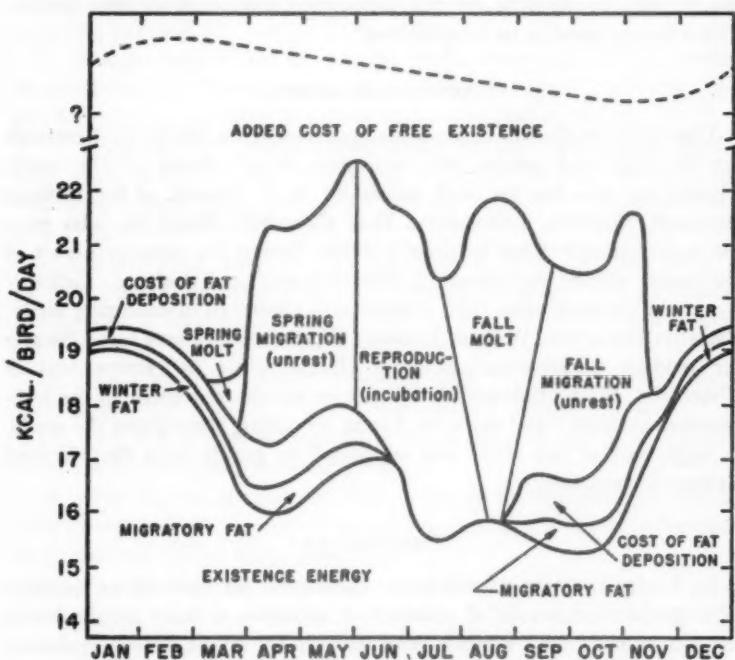


Figure 4. Total energy requirements of Tree Sparrows throughout the year. The lowest curve is that of existence energy to which the energy required by various activities has been added.

By adding the values for fat deposition, migratory unrest, reproduction, and molt to the average monthly existence requirements, the total energy expenditure of the Tree Sparrow can be plotted throughout the year (Figure 4).

The cost of living a free existence has not been measured but, due to greater difficulty in finding food, may well be more in the winter than in the summer. If this additional cost were added above the top curve in Figure 4, it might make the total energy intake more nearly the same throughout the year.

Tree Sparrows do not gain a more favorable energy balance by migrating northward each summer to breed, since the energy required for existence and incubation would be less in Illinois than at Churchill, and the energy requirement for migration would exist only for birds migrating to Churchill. The energy required for molting would be the same in the two localities. Undoubtedly factors other than energy balance are responsible for the northward migration of this species. These factors need to be investigated.

ACKNOWLEDGMENTS

The writer wishes to express his appreciation to Dr. S. C. Kendeigh for his continued advice and assistance in all phases of the work. Thanks are also due the staff, especially A. E. Cooney, of the Defence Research Northern Laboratory, Fort Churchill, Manitoba, who gave the writer complete use of their facilities during the summer aspect of the study; Dewar A. Burnett, J. Bristol Foster, and Walter L. Gillespie for providing invaluable field assistance at Churchill in capturing birds; Carleton Heckrotte, William Johnson, Clyde Robbins, and L. G. Swartz for tending experimental birds in Illinois while the writer was in Churchill; M. K. Fahnestock for measuring air movement in the temperature cabinets; and my wife, Lorna, for aiding throughout the study. A large part of this study was supported by grants from the National Science Foundation.

CONCLUSIONS

1. Under constant experimental conditions, an increase or decrease of temperature from 35° C results in a reduction of body weight due to the loss of body fat. Birds in wild natural conditions, however, show a weight and fat increase during the lower winter temperatures.
2. At experimental temperatures between -15° and -30° C, heavy birds metabolize more energy than light birds.

3. Gross energy intake per day increases linearly with decreasing temperature but at different rates on 10-, 15-, and 19-hour photoperiods.
4. The caloric value per gram of excrement does not vary significantly with photoperiod or temperature.
5. The amount of energy lost in the excrement per day increases linearly with decreasing temperature, with no significant difference among photoperiods. This increase is due to a greater volume of food digested at low temperatures.
6. Metabolized energy increases with decreasing temperature. Differences among photoperiods are explained by differences in night-time activity.
7. The efficiency of food utilization increased with temperature at all photoperiods. However, since digestion is more rapid on the short photoperiod, winter birds at 10 hours are less efficient than summer birds at 15 or 19 hours.
8. Metabolism is decreased above 30° C with no change of rate indicated between 35° and 39.5° C.
9. Energy metabolism of control birds under fluctuating outdoor temperatures in Illinois increases significantly with decreasing temperature, but at a slower rate than under constant conditions.
10. Churchill birds had a higher metabolic rate than Illinois birds at both high constant and fluctuating temperatures due to decreased feather insulation and onset of fall molt at the time of the experiments in July and August.
11. Nonmolting birds at Churchill during June and July have 25 per cent lighter plumages than in the winter in Illinois. Birds retained in captivity in Illinois during the summer lost only 6 per cent of their heavier winter plumage.
12. Short-term acclimation to low or high constant temperatures by altering plumage density does not occur in the Tree Sparrow.
13. The lower limit of temperature tolerance in the Tree Sparrow is the same throughout the year (-28° C).
14. The maximum observed daily capacity for metabolizing energy, such as occurs at the lowest tolerated temperature, is probably the same in all seasons (32.82 kcal./bird/day).
15. Energy required for existence under natural conditions is greatest during January in Illinois, the least in July at Churchill. If birds remained in Illinois during the summer, their existence energy requirement would be 26 per cent less than at Churchill.
16. The hourly rate at which existence energy must be accumulated is the same in summer at Churchill and Illinois.

17. The greatest amount of productive energy per day is potentially available during the summer. Therefore, energy-demanding activities such as migration, nesting, and molting are evenly spaced between April and October.

18. Since daily energy requirements become greater, the Tree Sparrow does not gain a more favorable energy balance by migrating north each spring. Factors other than energy relations are undoubtedly responsible for migration in this species.

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EGG TEMPERATURES OF THE RING-NECKED PHEASANT OBTAINED WITH A SELF-RECORDING POTENTIOMETER

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SEVERAL investigators have made detailed studies of the incubation temperatures of birds' eggs, and many incidental observations on the subject can be found in the literature. Eyclesmeyer (1907), Cadman (1923), Phillips and Brooks (1923), and Murry (1926) used mercurial thermometers to determine the temperatures of incubating eggs of the domestic fowl, while Moran (1925) was apparently the first to use thermocouples to determine such temperatures. Kendeigh and Baldwin (1930) were probably the first to employ thermocouples for investigating the incubation temperatures of the eggs of wild birds. Huggins (1941), using a thermocouple inserted into the egg through an opening made with an egg drill and sealed with collodion, found the egg temperature of the pheasant to vary from 32.7–38.2° C (91.0–100.8° F).

Kossak (1947) measured the incubation temperature of the Canada goose (*Branta c. canadensis*) by using a Leeds and Northrup pyrometer. He attached a thermocouple to the outside of the egg and found the average shell temperature was 38.0° C (100.4° F), and by inserting the thermocouple through the shell, he determined that the average temperature of the developing embryo was 38.5° C (101.3° F). His averages were obtained from approximately 30 measurements in four different nests.

Westerskov (1956) measured the incubation temperature of pheasants by the use of a potentiometer recorder. He placed the thermocouple in the center of the nest on top of the eggs but not in contact with the brood patch of the incubating hen. Measurements were made in a single nest from three to five times daily throughout the incubation period, and the average temperature during the attentive phase was 36.1° C (96.98° F). Holstein (1944) in his study of Danish birds of prey learned that the incubating bird does not warm the nesting material appreciably and that the nesting material assumes the air temperature up to the eggs. By thermoelectric measurements he determined that the internal egg temperature during incubation was approximately 4.8° C (8.6° F) more than the mean of the bird's temperature plus the air temperature. However, his studies were conducted with tree-nesting species. Measurements made during the present study with pheasants indicated that the temperature of the nesting material beneath the egg

was within approximately 1.5° C (2.7° F) of the temperature of the egg during incubation.

Koch and Steinke (1944) found that the body temperature of the domestic goose and the temperature at the dorsal surface of the egg varied from 0.5 – 0.7° C (0.9 – 1.3° F). Data in this paper deal with the egg temperatures of the Ring-necked Pheasant during the attentive phase of incubation and with the relationship between the average daily egg temperatures during the attentive period and the stage of incubation. The incubation temperatures were taken with a thermocouple attached to the small end of the egg. Data were collected during a study that was made to determine some effects of weather on pheasants during the reproductive season. A more complete coverage is given in my doctoral dissertation (Kessler, 1959).

METHODS AND MATERIALS

Most of the previous investigators measured the egg temperatures by inserting the measuring device through the shell. This method has the disadvantages of destroying the embryo and of introducing foreign matter into the egg. A method of measuring egg temperature was needed whereby the temperature could be measured without destroying the embryo, a method that could be used with the same egg throughout the entire incubation period.

Kossak (1947), in his work with geese, attached the thermocouple to the outside of the shell with tape. The same method was employed in the present study except that the thermocouple junction was glued to the egg.

A Leeds and Northrup Model G-S-6000 automatic recording potentiometer was used to measure incubation temperatures. This instrument recorded temperatures consecutively from 16 different locations and was adjusted to record temperature at each consecutive location every 30 seconds. The accuracy of the instrument was 0.3 per cent of the scale range -31.8 – 51.65° C (-25 – 125° F), and it had a sensitivity of 0.06° C (0.1° F). The machine was installed in a shelter near the center of the study area, and 24-gauge copper constantan thermocouples with extruded nylon insulation were extended to the nests under observation. Some of the nests studied were located over 300 feet from the recording instrument.

The study was conducted during 1955 and 1956 at the Delaware Farm Game Experiment Station near Delaware, Ohio. The study area was a five-acre plot, which was fenced with eight-feet-high poultry-mesh

fencing. The cover consisted of alfalfa and red clovers, timothy, and weeds.

The experimental stock consisted of Ring-necked Pheasants (*Phasianus colchicus torquatus*) from the Urbana State Game Farm located near Urbana, Ohio. The stock was brailed and released during March of each year of the study, and approximately 100 hens and 10 cocks were used each year. With the onset of the nesting season, the area was searched daily for nests, and when a nest was found before incubation of the clutch had started, a thermocouple was attached to the small end of an egg. A complete record of egg temperature for that egg throughout the entire incubation period was obtained.

Preliminary experiments were conducted to determine whether there was a difference between the temperature inside the egg and the temperature on the outside of the shell. This was done by using two thermocouples. A thermocouple junction was attached to the outside of the shell with Duco household cement; another thermocouple was inserted through a hole into the interior of the egg, and the hole around the thermocouple was sealed with Duco household cement. The egg with the two thermocouples was placed in a nest, and a hen was allowed to incubate. Simultaneous internal and external measurements showed an average difference of less than two degrees C between the temperatures measured internally and those measured externally. The external temperatures measured on the shell were usually lower. Kossak (1947) found that the shell temperature averaged approximately 0.4° C (0.7° F) less than the internal egg temperature.

Various locations of attachment of the thermocouple to the outside of the egg were tried, but measurements made with the thermocouple junction cemented to the small end of the egg corresponded most closely to the internal measurements. With the thermocouple in this location, the egg rotated freely in the nest, and the thermocouple junction did not touch the hen's body or the nesting material. This external placement of the thermocouples did not appear to interfere seriously with incubation, because most of the eggs with attached thermocouples hatched.

The egg temperature was recorded in each nest at eight-minute intervals throughout the entire incubation period. This means that approximately 170 measurements were used to compute each daily average temperature for each hen and that approximately 4,000 measurements were used to compute the over-all average egg temperature for any one hen during the entire incubation period. A study of the positions of the eggs during the incubation period revealed that the

eggs were shifted many times daily. By numbering the eggs in a clutch, their position could be determined each time the hen was off the nest. In several instances when a certain egg was at the periphery of the clutch, it was near the center when examined the next time, or vice versa. Shifting of the position of the eggs appeared to be as noticeable in large clutches (10 eggs or more) as in small ones. The important consideration here appeared to be that, due to the change in position in the nest, the incubation temperature for any particular egg varied from time to time throughout the incubation period and in no way could be considered constant. The temperature for any given egg, once the hen had been covering the clutch for a time sufficient for the eggs to reach incubation temperature, depended largely on the location of the egg within the nest. The temperature difference between the eggs in the center and those at the periphery of the nest varied widely; however, the difference was usually less than 2.75° C (5° F). The eggs in the center of the clutch came into contact with a larger surface of the hen's body than did the eggs near or at the periphery of the nest. The eggs near the outside of the nest may not have touched the hen's body at all, or they may have come into contact only with her feathers. In some instances the eggs were partially or entirely exposed.

Temperatures of two eggs in the same nest were recorded 30 seconds apart by using two consecutive points of the recorder. The clutch used was in the 18th day of incubation and contained nine eggs, of which seven hatched, including the two to which the thermocouples were attached. The maximum temperature difference recorded between the two eggs during this period was 2.75° C (5° F); however, the difference was usually $1\text{--}3^{\circ}$ C ($1.8\text{--}4.8^{\circ}$ F).

RESULTS

In 1955, complete records during the entire incubation period were made of the temperatures of one egg in each of five clutches. Five similar records were also made in five clutches during 1956.

Mean egg temperatures for the entire incubation period for each of the 10 clutches were calculated. Only the measurements taken when the hens were on the nests were used. During 1955, the mean temperature of the egg to which the thermocouple was attached in each of the five nests under observation was 36.8° C (98.3° F), 36.1° C (97.0° F), 35.7° C (96.3° F), 35.1° C (95.1° F), and 34.5° C (94.0° F); and, during 1956, the averages in each of the five nests under observation were 36.3° C (97.3° F), 35.7° C (96.2° F), 34.8° C (94.5° F), 34.6° C (94.2° F), and 33.3° C (92.0° F).

Westerskov (1956) found that the average incubation temperature, which he defines as "the temperature immediately above the eggs," was 36.1° C (96.9° F).

Table 20 in my dissertation (Kessler, 1959) shows the average daily temperatures of one egg in each of 10 different nests during the period of incubation. Egg temperatures when the hen was off the nest were not used in determining these averages.

The relationship between the mean daily egg temperature and the stage of the incubation period was investigated by using a parabolic regression.

The incubation temperature shows no consistent variation from nest to nest and is parabolic with time in only three of the 10 clutches under observation. In these three instances, the highest average temperatures occurred on the 12th, 13th, and 14th days, respectively, with relatively lower average daily egg temperatures at the beginning and end of the incubation periods.

Farner (1958) determined that the incubation temperature (*i.e.*, the temperature measured at the interface between the incubation strip and the egg) in the Yellow-eyed Penguin (*Megadyptes antipodes*), a species with an incubation period of about 42 days, increased gradually from 20–25° C (68–77° F) during the first two days to a maximum of about 38° C (100.4° F) at 15 days and that this maximum was maintained throughout the remainder of the incubation period. He also found a gradual decrease in the temperature gradient between the upper and lower surfaces of the egg to a level of about 5–8° C (41–46° F) during the latter half of the incubation period. Westerskov (1956), in the single clutch that he observed, found that the incubation temperature rose from 34.5° C (94.1° F) at the beginning of the incubation to 36.0° C (96.8° F) at the end; an increase of 3.5° C (6.3° F) between the onset of incubation and hatching.

ACKNOWLEDGMENTS

This paper is a contribution of the Ohio Cooperative Wildlife Research Unit. The equipment used was purchased by The Ohio State University, and I am grateful to Dr. D. F. Miller for his part in making this equipment available. I wish to thank Dr. E. H. Dustman for his advice during the study, and Drs. P. A. Stewart and Donald J. Borror for their critical advice in the preparation of the manuscript.

CONCLUSIONS

1. The temperature of an egg, once the hen had been incubating a sufficient length of time for the eggs to reach incubation temperature, appeared to be influenced by its location within the clutch. The highest temperatures were recorded when the eggs were in the center of the clutch, and the lowest when the eggs were at the periphery of the clutch.

2. Egg-temperature measurements were made every eight minutes throughout the incubation period of 10 hens—five hens during 1955 and five during 1956. The mean egg temperature measured during the attentive phase of incubation was calculated for each of the 10 clutches under study. The means of all recordings during the attentive phase were: in 1955, 36.8° C (98.3° F), 36.1° C (97.0° F), 35.7° C (96.3° F), 35.05° C (95.1° F), and 34.5° C (94.0° F); in 1956, 36.3° C (97.2° F), 35.7° C (96.2° F), 34.8° C (94.6° F), 34.6° C (94.2° F), and 33.3° C (92.0° F).

3. The relationship between the mean daily egg temperature and the stage of incubation was investigated by attempting to fit a parabolic regression to the data. The regression showed the temperature was a parabolic function of time in only three of the 10 clutches. If there was a parabolic or a linear relationship in the other seven clutches, it was not demonstrated by the data, since there was no consistent pattern from nest to nest.

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THE CRUSHING OF *CARYA* NUTS IN THE GIZZARD OF THE TURKEY

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IT is well known that the Wild Turkey (*Meleagris gallopavo*) feeds avidly on wild pecans, swallowing the nuts entire. In 1890 Geombeck, writing from Arkansas, doubted that it was generally known that turkeys feed on hickory nuts on which they become very fat. Webb (1941) in his study of the winter food of the Wild Turkey in Alabama (based on 38 crops and gizzards) reported that 2.95 per cent consisted of the fruit of hickories (*Carya* spp.). The spring foods (based on 116 crops and gizzards) consisted of 2.61 per cent of the fruits and flowers of hickory and pecan (Good and Webb, 1940). Martin (1951) lists the hickory as furnishing a winter food for turkeys in the southeast. A. L. Nelson kindly examined the original food cards at the Patuxent Research Refuge. Occasionally the pecan was mentioned, but in the great majority of cases the identification was generic. During the severe winter of 1946-1947 in West Virginia, Glover (1948) reported that on two areas Wild Turkeys had eaten hickory nuts that were over a year old. Having personally never found in the wild a sound hickory nut of this age, I wrote to R. Wayne Bailey for further information. He replied that Glover's statement was probably based on observations of turkeys scratching under hickory trees, and that he had never found a viable nut over a year old. He added: "There is no question about turkeys eating good hickory nuts. We have seen them in crops and in droppings. Generally, they eat those that squirrels have opened."

Over two centuries ago, Réamur (1756), in his experiments on avian digestion, forced English walnuts (*Juglans regia* L.) down the throat of a domestic turkey. Beginning with one nut, the number was gradually increased until the dosage numbered 24. Even this large number left the crop within 24 hours, as determined by palpitation. He stated that the nuts were of the ordinary size, some being very large. If their size was comparable to that of the nuts found in the market today, it is quite remarkable that the gizzard could handle 24 of them in as many hours. Until visiting a country home in France, Trebeden (1902) did not know that it was customary to fatten turkeys by force-feeding the entire walnut.

The main objective of my experiments was to determine the length of time that pecans and hickory nuts remained in the gizzard before

being crushed. The experiments were conducted with 16-month-old female domestic Broad-breasted Bronze turkeys. The temperament of the wild bird is such as to make it a poor subject for experiments of this nature. The preliminary work was done with a 14-month-old gobbler to determine the approximate length of time that the nuts required for comminution. Holes 2 mm. in diameter were bored through the shell of the nuts, part of the kernel removed and the cavity filled with a dye. Both methylene blue and crystal violet were employed. The opening was plugged in some cases with nitrocellulose lacquer, in others with a hydrocarbon of high melting point, care being taken that the plugs extended well below the inner surface of the shell. The methylene blue was destroyed in the process of digestion, but the crystal violet appeared in the feces unchanged. The fragments of shell in the latter were so small as to be scarcely detectable. A gelatin capsule containing crystal violet was given to the turkey at 9:20 A.M., and the dye appeared copiously in the feces at 1:00 P.M. Using pecans (*Carya pecan*) containing crystal violet, a nut administered at 8:35 A.M. showed some dye in feces at 12:20, but the color was not intensive until 3:00 P.M. In the case of similar experiments with the nuts of the shellbark hickory (*Carya ovata*), the earliest appearance of dye in the feces was 10 hours. It became apparent that the data were unreliable and that the plugs were being forced into the nuts by the gravel or other inert materials in the gizzard, thereby permitting escape of the dye long before the nuts were crushed.

It was found that if a nut was given to the bird when the crop was completely empty it passed almost immediately into the gizzard, as shown by palpation; however, if there was food in the crop the time of passing to the gizzard varied. Accordingly, the birds were not fed during the 24 hours preceding the experiments. It was apparent that no reliable data could be obtained except by killing the turkeys at intervals after the force-feeding of the nuts. I will here express my great thanks to Professor Frank L. Cherms, Department of Poultry Husbandry, University of Wisconsin, who not only provided 15 turkeys but killed and dressed them so that the gizzards could be examined. This cooperation removed the difficulty to be encountered in working with commercial poulters.

The wild pecans used came from Throckmorton County, Texas, and averaged 2.5 cm. in length by 1.5 cm. in width. On account of their thicker shell, they were used in place of the larger and thinner-shelled wild pecans supplied from Kerr County, Texas, by Colonel L. R. Wolfe. The hickory nuts, collected in Dane County, Wisconsin, aver-

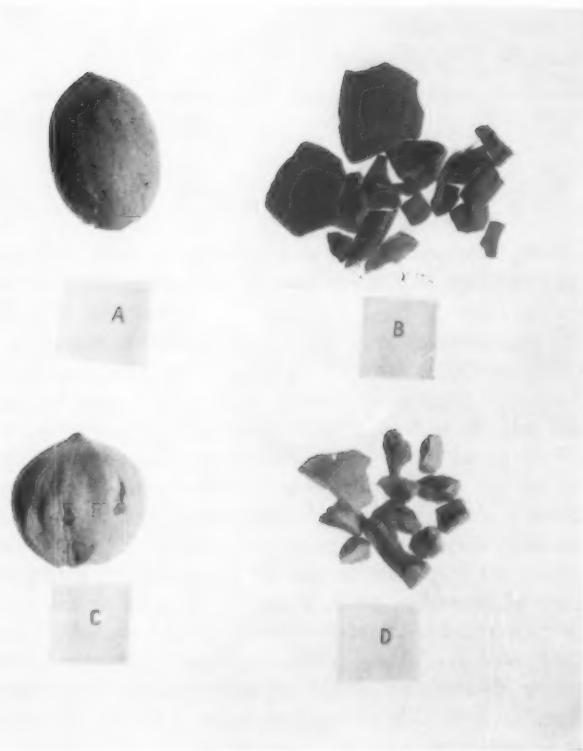


Figure 1. A. Natural pecan. B. Pecan after remaining in the gizzard one hour. C. Hickory nut showing incipient fracture. D. Hickory nut after remaining in the gizzard for 31 hours.



aged 2 cm. in length and 2 cm. in greatest width. Their crushing strength was determined at the Forest Products Laboratory, using 14 nuts of each species of *Carya* selected for uniformity in size and shape. The pressure, in pounds, is merely the load required to fracture the nut. The results are given in the following table:

		<i>Pressure in Pounds</i>	
		<i>Parallel to suture</i>	<i>Perpendicular to suture</i>
Hickory Nut	Range	124-202	198-336
	Average	167	257
Pecan	Range	42.5-96	60-110
	Average	66	79

The above data show great variability in crushing strength of apparently identical nuts and explain in part the lack of uniformity in crushing obtained in the gizzard.

Check experiments showed that pecans were crushed after remaining in the gizzard for one hour (Figure 1). Pecans recovered after periods of one-half and three-fourths of an hour in the gizzard were unchanged. In two experiments hickory nuts were crushed in 30 and 32 hours, respectively; however, in two other experiments lasting 30.5 and 31 hours the hickory nuts showed wear on the surfaces but no fractures. The pecans are crushed without apparent wear, but this is not the case with hickory nuts. The muscular action of the gizzard combined with the gravel grinds the surface of the nut, smoothing of the ridges of the latter being conspicuous, until a small cavity is formed by forcing the shell inward. One nut recovered after six hours had a cavity 1 x 3 mm., and another, after eight hours, a cavity 3 x 6 mm. (see Figure 1). There is no reason to believe that the disintegration of the nuts is other than mechanical. While it might be expected that the nuts would separate at the suture, this is not the case. Hickory nuts kept in water at room temperature for 30 days showed no weakening at the suture.

The times required to crush the nuts, one hour for pecans and 30 to 32 hours for hickory nuts, must be accepted as only approximate. The experiments were conducted with domestic female turkeys accustomed to soft foods and having a less powerful gizzard than the males. The wild birds, accustomed to harder foods, might crush the nuts in a shorter time. Two factors are important in preventing duplication of results: (1) the great variation in resistance to fracture of nuts, over which there can be no control; (2) the "psychological" condition of the turkey. A pecan, recovered after seven hours in the gizzard of one hen,

though showing considerable smoothing, was still intact. Ligon (1946) mentions seeing some old Merriam's Wild Turkeys, trapped with full crops, so badly frightened that digestion ceased entirely, the birds eventually dying.

It is yet to be proved that the Wild Turkey will eat the ordinary hickory nut in any quantity. If it does, it may select the bitternut (*Carya cordiformis*), the thin shell of which is not much more resistant to crushing than that of the pecan. An attempt over a period of two weeks to condition a male turkey to eating pecans and hickory nuts failed. When the cracked nuts were offered, the loose meats were eaten, but rarely if a piece of the shell remained attached.

In addition to the assistance rendered by Professor Cherms, Charles B. Norris made arrangements for the mechanical tests.

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NOTES AND NEWS

Mrs. Harriet Buchheister, wife of Carl W. Buchheister, President of the National Audubon Society, has an appeal that she hopes will bring help from readers of *The Auk*. For several years she has been working with crippled or blind and otherwise handicapped children and bringing joy and instruction into their lives by letting them learn birds by handling bird skins and mounted specimens. Unfortunately, the specimens wear out and need to be renewed occasionally. Will all those who collect and have extra specimens—either prepared skins or mounted ones—please send them to Mrs. Buchheister at 1239 Madison Avenue, New York City, New York. If new fresh skins or mounts are made, she asks you please to use borax instead of arsenic in their preparation and indicate same.
—JOHN K. TERRES, *National Audubon Society, 1130 Fifth Avenue, New York 28, New York.*

The American Museum of Natural History, New York 24, New York, announces that a postdoctoral fellowship for one year will be available in its Department of Birds, beginning on 1 October 1960. Inquiries may be directed to the Chairman, Department of Birds.

The Biological Photographic Association will hold its 30th annual meeting in Salt Lake City, Utah, 23–26 August 1960. Headquarters will be at the Hotel Utah Motor Lodge. All persons interested in biological photography are invited to attend (membership not necessary). For further information write Howard E. Tribe, Division of Medical Illustration, University of Utah, Salt Lake City. The B.P.A. is an international organization and the only one of its kind in the United States.

A conference on the potential role of birds in the epidemiology of certain viruses affecting man was held at the National Institutes of Health on April 4, 1960. The purpose was to bring ornithologists and virologists together in a joint effort to suggest solutions for these problems. A result of the discussions was recognition that many ornithological aspects need more research. For example, dates of arrival and of departure, numbers of migrants, distribution in South America and in southern United States, and also several physiological aspects are important problems that ornithologists might explore in more detail. The Public Health Service supports basic research that often has intrinsic ornithological value. Information about applications for grants may be obtained from: Research Grants Division, U.S. Public Health Service, Bethesda 14, Maryland. The ornithologists present at the conference were David E. Davis, Pennsylvania State University, University Park, Pennsylvania; Mr. Allan Duvall, Patuxent Research Refuge, Laurel, Maryland; Mr. William H. Gunn, Ontario Society of Naturalists, Toronto, Canada; and Dr. Herbert Friedmann, U.S. National Museum, Washington 25, D.C.

GENERAL NOTES

Great Auk and Common Murre from a Florida Midden.—Among bird bones from archeological sites submitted for identification by Ripley P. Bullen of the Florida State Museum are the proximal portion of a right humerus of the Great Auk (*Pinguinus impennis*) and the proximal portion of a left humerus of the Common Murre (*Uria aalge*). The collecting locality, known as Summer Haven midden (site No. SJ 46), is located on the east side of the Inland Waterway, immediately south of Matanzas Inlet, in St. Johns County, Florida. The site produced only decorated, fiber-tempered pottery of the late Orange period and is dated by Mr. Bullen at about 1000 B.C.

Other species of birds identified from the Summer Haven midden include the Common Loon (*Gavia immer*) with 11 bones from at least two individuals, the Gannet (*Morus bassanus*) with 9 bones from at least two individuals, and the Wild Turkey (*Meleagris gallopavo*) with a single carpometacarpus. The loon and the gannet occur in Florida only as winter visitants. The presence of these two species and the two alcids indicates winter occupancy of the site.

The Common Murre is previously unrecorded south of New Jersey, whereas the Thick-billed Murre (*Uria lomvia*) has occurred accidentally as far south as the Carolinas (American Ornithologists' Union, 1957). The humeri of the two species of *Uria* may be differentiated by the overhanging lip between the head and the external tuberosity being strongly concave in internal view in *U. aalge*, straight to slightly concave in *U. lomvia*.

There are two previous records of the Great Auk from middens in Florida. That from the Cotton midden north of Ormond (Hay, 1902) likewise represents the late Orange archeological period and has now been dated by the radiocarbon method as 1060 B.C. \pm 200 (Griffin and Smith, 1954). The record from the Castle Windy midden south of New Smyrna Beach is from the much-later St. Johns II archeological period (Weigel, 1958). Since publication of the latter record a series of radiocarbon dates from the site have been received, with the auk level dated at 1307 A.D. \pm 100 (Bullen, 1958; Bullen and Sleight, 1959). All three Florida localities of the Great Auk are from the banks of the Inland Waterway, but it seems likely that the birds were taken offshore and brought to camp.

Analysis of the bird remains from the three archeological sites mentioned above and from Green Mound midden near Daytona Beach (Hammon, 1959) suggests that there were two periods of cool climate in Florida prehistory: one about the year 1000 B.C., the other about 1000 A.D.

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—PIERCE BRODKORB, Department of Biology, University of Florida, Gainesville, Florida.

A Probable Hybrid of *Larus argentatus* and *L. marinus*.—Hybrids between the Herring Gull (*Larus argentatus*) and the Great Black-backed Gull (*L. marinus*) have been produced under captive conditions on several occasions. Palmgren (Medd. Soc. Fauna Fl. Fenn., 44: 250-251) has reported offspring from the mating of an *argentatus* ♂ to a *marinus* ♀, and Heinroth (Jour. für Ornith., 53: 256-258) has noted young by the reciprocal cross. However, these and other reports in the literature are distinguished by the nearly complete lack of descriptions of the hybrids at any age, and I am unable to find any reference to this interspecific cross having occurred under natural conditions.



Figure 1. Primary pattern of *L. argentatus* x *L. marinus*. (Drawn by Helen Hays.)

On 10 January 1959 I collected a large, darker-backed gull from a flock of Herring Gulls feeding on a garbage dump on Staten Island, New York. The bird was an adult female in winter plumage with ovary 13 mm. in length; it weighed 1,423 gms. and was moderately fat. I had expected that the specimen (AMNH No. 707766) would be referable to one of the darker-backed races of *L. argentatus*; yet, comparison of the bird with specimens in the American Museum of Natural History indicated that such was not the case. Not only was the bird too large for any race of *argentatus*, but also the mantle color was too dark for inclusion in the *argentatus* group, and too light for inclusion with the *fuscus* group. Dwight's (1926) key suggested that the bird might be a Slaty-backed Gull (*L. schistisagus*), but reference specimens showed that the mantle was too light for this species or the Western Gull (*L. occidentalis*), although the measurements were comparable. Mr. Eugene Eisenmann suggested that the bird might represent a hybrid between the Herring and Great Black-backed gulls, and with this I fully concur.

Description. Head and neck white with wide, dark-brown streaking sparsely scattered on the occiput and nape. Mantle: Best matched by the Neutral Gray of Ridgway (1912) and extremely similar to that of the California Gull (*L. californicus*). Wing: The primary pattern is illustrated in Figure 1. The outer 60 mm. of the 10th (outermost) primary are white with only a trace of black 15 mm. from the tip of both vanes. The 9th primary is crossed by a large, white, subterminal band, which is extensive on both vanes. Other primaries are not noticeably different from those of the supposed parent species except in ground color, which is a reflection of mantle coloration. Tail and underparts white. Bill yellow with red spot at gonyx. Iris pale yellow. Orbital ring deep chrome-yellow. Legs pale grayish-white with faint flesh tone.

Measurements. The dimensions of the specimen are contrasted with those given by Dwight (1926) for adult females of *L. argentatus smithsonianus* and *L. marinus*.

	<i>L. a. smithsonianus</i> (16 ♀)	Hybrid	<i>L. marinus</i> (7 ♀)
Wing (chord)	397-422 (410.6)	436	454-491 (465.8)
Tail	154-178 (165.3)	172	181-209 (189.4)
Tarsus	57-66 (62.1)	70	74-81 (75.7)
Exp. culmen	47-53 (50.1)	57	57-66 (60.7)
Bill (base)	16-18 (17.0)	22	21-24 (22.3)
Bill (angle)	17-20 (18.0)	21.5	22-27 (24.0)

Discussion. The measurements show that the specimen is essentially intermediate in size between *argentatus* and *marinus*. The tail falls within the limits of *argentatus*, but the massive bill clearly approaches *marinus*. The relative sizes of the three birds are indicated in Figure 2, which also shows the mantle color of the hybrid to be nearer *argentatus* than *marinus*. This coloration agrees with the only available description of a known hybrid. Heinroth (*op. cit.*) described the mantle of the one hybrid he studied that attained adult plumage as being "etwas dunkler als das die Mutter [*argentatus*] ist."

Another point supporting hybrid origin is the character of the occipital streaking: the streakings of the specimen are identical in shape and color to those of *marinus*. The pattern of the primaries, often used in gull taxonomy, approaches that of many specimens of *marinus*, but differs from most United States specimens

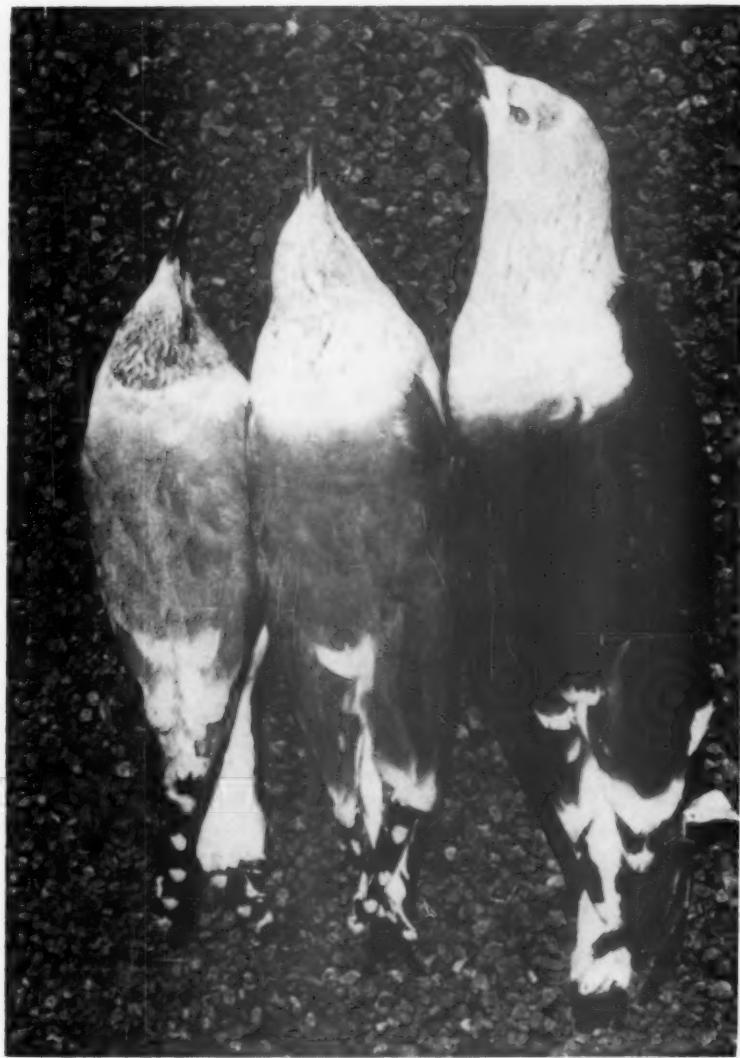


Figure 2. Left: *Larus argentatus smithsonianus* (Ad♀); middle: *L. argentatus* x *L. marinus* (Ad♀); right: *L. marinus* (Ad♀). All birds in winter plumage.



Figure 1. Rivoli's Hummingbird observed in Colorado.

of *argentatus* in that the tip of the 10th primary is essentially white. However, primary patterns are highly variable, and differences may even be noted between the wings of the same bird. Since the patterns of the supposed parent species are often similar, it is felt that this character is not definitive but may be indicative of relationship.

The color of the orbital ring in gulls has been considered to have taxonomic implication. In this case, the color, chrome-yellow, is neither that of *marinus* (red) nor of five adult *argentatus* examined in life at the same locality during January 1959 (orange or yellow-orange). However, there is some evidence that different populations of *L. a. smithsonianus* may show differences in orbital ring color. In any case, the hybrid was in wintering, not breeding, condition, and, thus, the color of the orbital ring is not of extreme significance.

The color of the legs, too, agrees with neither of the supposed parents. But modifications in leg color of larids in winter are frequent enough that we may consider this bird as a variant.

Miss Helen Hays prepared the sketch of the gull's primary pattern, and Mr. Eugene Eisenmann made many helpful suggestions during the preparation of this paper.—JOSEPH R. JEHL, JR., 385 Grove Street, Clifton, New Jersey.

Rivoli's Hummingbirds in Colorado.—A male Rivoli's Hummingbird (*Eugenes fulgens*) was observed in Jackson County, Colorado, for a period of about five weeks during the summer of 1942. The bird came regularly to feeding bottles placed in an aspen grove at an elevation of 8,700 feet (Bailey, Auk, 62: 631, the only report).

During the summer of 1959 at least one and probably two other birds were observed in Colorado. Mrs. M. F. Shickley of Eldora reported that a female Rivoli's was seen at a feeding bottle at her summer home near Eldora, Boulder County, on 10 July 1959. The following morning the bird appeared again. Patricia Bailey Witherspoon and I were able to take a few photographs of the rare bird. The Shickley's home is on the north slope of an aspen-clad mountain at 8,500 feet elevation. We arrived at 5:30 A.M., 19 July, and Mr. and Mrs. Shickley reported the bird had been active and had been at the bottles several times, even though the early-morning temperature on the feeding station was 4.4° C (40° F). During the next two hours the large-sized, light-colored bird, with the distinctive throat streaks and white spots behind the eye, came in three times, and we were able to secure photographs.

Mrs. Shickley observed the bird at irregular intervals during the next two weeks, and it was last seen on 24 July. On 10 August a neighbor, who also had feeding bottles, reported seeing a large hummer with a bright-green throat once in the morning and again in the evening: "a bird so large which flew so slowly I thought at first it could not be a hummer." Although a careful watch was kept, this bird was not observed again.

Mr. H. B. Allesbrook saw a hummingbird "fully three-fourths of an inch larger than any Broadtails" at his feeding station five miles southwest of Estes Park for two seasons—the bird being last sighted in 1958 on 1 September. On 9 August 1959 the bird, or another, appeared; it was noted three times on 30 August, and on several occasions on 5 and 6 September. The previous week a neighbor, Mrs. John Tutt, had a large hummingbird coming regularly to her feeding bottles. In reporting to us by letter of this strange bird, Mr. Allesbrook referred to it as a

"Blue-throated Hummingbird." But no definite identification was made, and unless future observations prove otherwise, it may be assumed to have been a Rivoli's.

On 11 August Mrs. Shickley again saw a large hummer at her feeder, but the bird was chased away by the pugnacious Rufous Hummingbirds (*Selasphorus rufus*). Two days later, however, a Rivoli's was seen, and noted continuously throughout the rest of the month and during the first two weeks of September. We made several trips and secured additional photographs, but we are not certain that the bird was the same individual noted in July. Certainly it seems likely that at least three large hummingbirds were observed in the Transition Zone of Colorado during the summer of 1959: the female at the Shickley's and the male at the neighbors, and the female observed by Mr. Allesbrook near Estes, 50 air miles away from Eldora. A bird was seen repeatedly at both stations on the same dates, so at least two must have been noted.

Photographs were submitted to ornithologists of the Chicago Natural History Museum, the American Museum of Natural History, and the National Museum who kindly compared specimens in their collections with our pictures. All concurred with our identification.—ALFRED M. BAILEY, *Denver Museum of Natural History, Denver, Colorado*.

Greater and Lesser Scaup Feeding on Dead Gulf Menhaden.—Available studies of stomach contents indicate that mollusks are the favorite food of scaup in coastal waters. Cronan (Auk, 74: 459–468, 1957) analyzed the stomach contents of 119 Greater Scaup (*Aythya marila*) and 129 Lesser Scaup (*Aythya affinis*) collected in Connecticut waters from October 1952 to May 1954. Foley and Taber ("Long Island Waterfowl Investigations," P.R. Proj. 52-R, Final Report, New York Cons. Dept., 296 pp., 1952) gave data on 63 Greater and 12 Lesser scaup from the Long Island Sound region. Cottam's summary (USDA Tech. Bull. 643, 140 pp., 1939) of food habit studies of scaup included a large group of Greater Scaup taken on or near Pacific coast oysterbeds (Kubichek, Iowa St. Coll. Journ. Sci., 8: 107–126, 1933). Animal foods were more predominant in the diet of scaup in coastal waters than in fresh waters and Lesser Scaup ate a greater percentage of plant food than Greater Scaup. The most important animal foods were mollusca.

Steele ("The Rise and Decline of the Olympia Oyster," Elma, Washington, Fulco Publ., 126 pp., 1957) noted (p. 73) that the "Blue Bill" was included in ducks feeding on planted seed of the Olympia oyster (*Ostrea lurida*). A patrolman, employed by the Oyster Bay Growers Association from 1914 to 1925, shot ducks on the oysterbeds in Olympia Bay, Washington, to reduce predation. An investigation in 1914 by McAtee (Cf. McKernan, Tartar and Tollefson, Washington Dept. Fisheries Biol. Bull., 49-A: 118–165, 1949) showed that Greater Scaup fed on Olympia oysters, but the estimated quantity eaten by ducks was not enough to contribute significantly to depletion of oysterbeds.

Burleigh ("Georgia Birds," Norman, Univ. Okla. Press, 748 pp., 1958) stated that the Greater Scaup was "noticeably maritime" on the Atlantic coast, where it secured its food, principally mollusks living on the bottom, by diving in offshore waters eight to ten feet deep. Lesser Scaup preferred fresh water and a vegetable diet, although ". . . to some extent such animal food as small fish, tadpoles, small mollusks and water insects are eaten" (p. 154).

The fact that Lesser Scaups, under certain circumstances, are scavengers is reported by Kortright ("The Ducks, Geese, and Swans of North America," Wash-

ington, The Am. Wildlife Inst., 476 pp., 1943). Stomach contents showed that a number of these birds had fed at the mouth of a sewer.

Today scaup are the most common wintering ducks in Mississippi's estuarine waters, where they rest and feed in large rafts on the bays and Mississippi Sound and in smaller groups along the bayous and streams. In mid-January 1958 a pair of Greater Scaup were observed in the Gulf Coast Research Laboratory boat slip, a small bayou connecting with Davis Bay, with a group of feeding mergansers. The mergansers were feeding on small live fish, probably mullet (*Mugil cephalus*), which they often brought to the surface to swallow. Some Gulf menhaden (*Brevoortia patronus*) carcasses had been dumped into the water after being measured. The scaup were seen bringing these menhaden to the surface, where fish too large to swallow were broken into smaller pieces and eaten. The ducks soon lost their fear of people on the boat and docks and fed regularly in the narrow slip where the water was five to eight feet deep.

Other scaup, both Greater and Lesser, soon joined the original pair, and as many as nine were constantly diving in the area, where additional menhaden were dumped periodically. Any sudden noise or movement caused the little flock to fly 50 to 100 yards away, to return at once to the feeding ground. When the writer left the Laboratory at the end of January for a two-week field trip, the scaup were still devouring discarded menhaden. They were not seen in the slip again after menhaden were no longer discarded, although many scaup were in the vicinity. Recorded surface-water temperature ranged from 10.8 to 12.2° C, and salinities varied between 3.6 and 18.0 o/oo during this period. Since that time scaup have been occasional visitors in the Laboratory slip, but only in groups of two or three that remain quite wild and do not stay very long.

Another instance of scavenger feeding by scaup was reported to me by Mr. O. L. Seymour of Ocean Springs, Mississippi. In the past, processors loaded discarded shrimp heads on a small barge that was unloaded in Biloxi Bay between the Highway 90 bridge and the L. & N. Railroad bridge. Feeding scaup gathered in large numbers in the dumping area, where they apparently fed on the discarded shrimp heads and remained as long as this food was available.—J. Y. CHRISTMAS, *Gulf Coast Research Laboratory, Ocean Springs, Mississippi*.

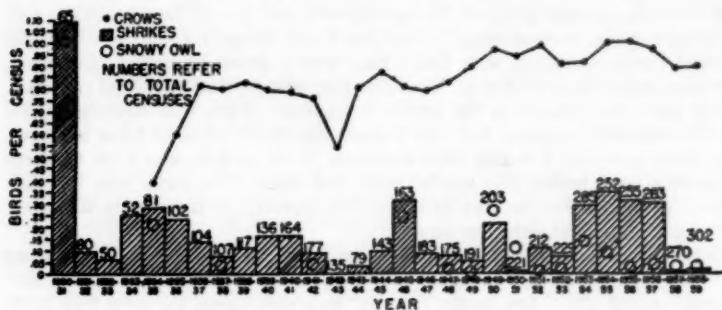
A Le Conte's Sparrow at Beaupré, Province of Quebec.—On 21 May 1935, a bird, which was then believed to be a Sharp-tailed Sparrow (*Ammospiza caudacuta subvrgata*), was collected at Beaupré, some 25 miles northeast of Quebec City, by the late Dr. Gus. A. Langelier.

Recently, while revising the Langelier collection, which now belongs to the Quebec Provincial Museum, it appeared to me that the specimen previously identified as a Sharp-tailed Sparrow was of a different species. In fact, it was reidentified as a Le Conte's Sparrow (*Passerherbulus caudacutus*). The new identification was verified by Mr. W. Earl Godfrey of the National Museum of Canada.

Apparently, this specimen is the first record for the Province of Quebec and the first mention east of Bradford, Ontario (A.O.U. Check-list 1957: 593). The specimen is an adult male, catalogued No. 4971 in the Quebec Provincial Museum collection.—MRS. GUS. A. LANGELIER, *Musée de la Province, Parc des Champs de Bataille, Quebec, Canada*.

Recent Emigrations of Northern Shrikes.—The Northern Shrike (*Lanius excubitor*) formerly appeared in the northern states at intervals of about four

years (Davis, Auk, 54: 43-49, 1937) but more recently at intervals of four, five, and six years (Davis, Auk, 66: 293, 1949). The present note summarizes data for the past 10 years. As in the previous two papers, the Christmas censuses



narrow streamcourse. From a steep slope I watched the male drop to the level creekbed below me and walk away from the female in an exaggerated manner that reminded me of Tinbergen's (1939, Trans. Linnaean Soc. New York, 5, fig. 17) sketch of the display of the Snow Bunting (*Plectrophenax nivalis*) male before the newly arrived female. After his single promenade the male flew southward, and then back to the north of the creekbed, singing as though visiting the outposts of his territory. After the male's departure the female flew downstream and inspected some yucca blossoms. Subsequent activity of a pair of orioles (not certainly these individuals) was centered some 200 yards to the north of this site.—

KEITH L. DIXON, Department of Zoology, Utah State University, Logan, Utah.

A Record of *Pipilo erythrorthalmus arcticus* in North Carolina.—An additional specimen of the Rufous-sided (Spotted) Towhee, now in the North Carolina State Museum in Raleigh, North Carolina, may further modify the distributional status of this species as now recorded in the A.O.U. Check-list (1957), and amplified by P. A. Buckley's report of New York specimens.

The bird, a male, first visited my Fayetteville feeder on 10 February 1957, and was seen many times each day until I trapped it on 14 February. I called on Mr. Henry Rankin for assistance in properly identifying the bird before banding and releasing it, but it did not survive overnight captivity. The bird was taken to the State Museum for skinning and sent to the United States National Museum for species identification. The following report was sent to Harry T. Davis, Director, North Carolina State Museum.

"Dr. Aldrich examined the towhee specimen and identified it as *Pipilo erythrorthalmus arcticus*, although showing a tendency toward intergradation with *erythrorthalmus*; the back is darker than that of *arcticus* and so approaches that of *erythrorthalmus*. The amount of white in the tail is variable in all races, but in your specimen it approaches that of *erythrorthalmus* more closely than *arcticus*. It has the spotting of the back and wings of the western races, and therefore in general appearance is more like them than the non-spotted eastern races. . . ." —DORIS C. HAUSER, 309 Sylvan Road, Fayetteville, North Carolina.

Song Sparrow Feeds on Dandelion by Unusual Method.—On 19 April 1959, I watched a previously color-banded male Song Sparrow (*Melospiza melodia*) foraging along the garden at my home in Norfolk, Virginia. He approached a dandelion plant having three stems, all of which possessed heads with some seeds. Stretching up very high on his legs, he pecked a seed from the lowest head and repeated the action. Then he looked up at the seed head of the highest stem, which he could not have reached without jumping. The sparrow immediately hopped to the base of the plant and placed one foot on the stem about three-quarters of an inch from the ground. The stem was originally at an angle of about 50° from the vertical, and the bird placed his foot on the "top" side of the stem, an action that pushed the stem farther toward the ground in the same direction it had been bent. He then hopped on the stem, which bent to the ground under his weight, and inched his way up the stalk with "side-steps." When reaching the head at the end of the stalk, he ate five or six seeds, then hopped off the stem where he had stood throughout the feeding, and hopped back to the base of the plant. This time he stepped on the stem of the remaining seed head, but suddenly flew off before bending the stem all the way to the ground.

There are many accounts of emberizines jumping to or hovering by food out of reach, and pulling down seed heads with the bill, but I know of none involving a

seemingly insightful action. Miller (*Condor*, 41: 255-256, 1939) watched a Lazuli Bunting (*Passerina amoena*) seize grass heads in its bill and pull them down to a fence wire, where they were held with the feet while feeding; but this behavior is actually quite similar to pulling the seed head to the ground with the bill, and is an extension of the normal feeding behavior. Thorpe ("Learning and Instinct in Animals," 1956, p. 100) defines insight-learning as "the sudden production of a new adaptive response not arrived at by trial behaviour or the solution of a problem by the sudden adaptive reorganisation of experience." It is possible that the Song Sparrow's behavior is an example of true insight, but to assume so without full knowledge of the individual's previous perceptual experience is unwarranted.—JACK P. HAILMAN, 4401 Gladwyne Drive, Bethesda, Maryland.

Notes on the Systematics of the Tanager Genus *Conothraupis*.—In 1939 Berlioz (*Bull. Brit. Ornith. Club*, 59: 102) described *Rhynchothraupis mesoleuca*, a new genus and species of tanager from Juruena, northeast of Cuyaba, Mato Grosso, Brazil, and in 1946 published Barruel's attractive colored plate (*Oiseau*, n. ser., 16: opp. p. 1) with a further account of the species. Zimmer (*Amer. Mus. Novit.* No. 1367: 20, 1947), after comparing Barruel's plate with specimens of the rare Peruvian species, *Conothraupis speculigera*, concluded that the differences between the two forms "can be no more than subspecific."

Subsequent to 1946, Professor Berlioz acquired a male of *speculigera*, and in 1954 kindly permitted me to compare it with the type of *mesoleuca*. The two forms are quite clearly congeneric; however, I prefer to consider them full species. The tail is relatively shorter in *mesoleuca* (81 per cent of the wing length, as against 88 per cent in *speculigera*). In addition to the black (versus gray) rump and flanks, largely black (versus white) under tail coverts, and greatly reduced speculum, *mesoleuca* has a greenish sheen to the black of the plumage whereas *speculigera* has a purplish sheen. Both species inhabit arid forest or scrub (cf. Berlioz, *Oiseau*, n. ser., 16: 3, 1946, and Carriker, *Auk*, 51: 497, 1934), but the known ranges of the two species are separated by approximately 1,500 miles, much of the intervening country consisting of humid, tropical lowlands. This suggests that the two populations have been geographically isolated from each other long enough for speciation to have occurred.

Hellmayr (*Field Mus. Nat. Hist. Publ., Zool. Ser.*, 13: pt. 9, 433, 1936) credits the genus *Conothraupis* to Taczanowski (*Proc. Zool. Soc. London*, pl. 21, p. 198, 1880 [read 16 March 1880]) but remarks in a footnote that the name "should probably be credited to Sclater, for it seems unlikely that Taczanowski's paper was actually published before the appearance of the April number of 'The Ibis.'" Inasmuch as Taczanowski's paper contains a page reference (footnote, p. 198) to Sclater's description (*Ibis* [4], 4: 252, 1880), it is quite clear that Sclater's description was published first. The nomenclature of the genus should thus stand as follows:

Genus *Conothraupis* Sclater
Conothraupis speculigera (Gould)
Conothraupis mesoleuca (Berlioz)

The systematic position of *Conothraupis* remains to be determined. Although Berlioz (*Oiseau*, n. ser., 16: 2, 1946) placed *mesoleuca* among the tanagers, he pointed out the possibility that in spite of the differences in bill form, it might turn out to be a finch allied to *Sporophila*. This possibility is supported by the

strong resemblance of the plumage of both species of *Conothraupis* to some of the seedeaters, notably to *Sporophila luctuosa*. Zimmer (*loc. cit.*) also expressed uncertainty as to whether *Conothraupis* belonged among the finches or the tanagers, whereas Hellmayr (*loc. cit.*) believed *C. speculigera* to be "nearly related to *Lamprospiza melanoleuca*."

In my opinion, the systematic position of *Conothraupis* and of several other "tanagine" genera, including *Schistochlamys*, *Cypsnagra*, *Neothraupis*, *Nemosia*, *Cissopis*, and *Lamprospiza*, remains to be determined. Of the genera listed among the tanagers by Hellmayr, *Conothraupis* seems to me closest to *Schistochlamys* and *Neothraupis*, whereas close relationship to *Lamprospiza* seems to be precluded by the brightly colored bill, pointed wings, pattern of sexual dimorphism, and rather high gloss of the black in the plumage of that genus.—ROBERT W. STORER, *The University of Michigan Museum of Zoology, Ann Arbor, Michigan.*

Arctic Loon at Palm Beach.—An Arctic Loon (*Gavia arctica*) was found dead on the causeway to Ibis Island on 21 November 1959 by the writer. The short, straight bill and the small size of the body aroused the suspicions of Mr. Robert Cointepoix, Mrs. Roberta Knight, and the writer. Mr. Cointepoix collected and mailed the head and a foot to Dr. Alexander Wetmore, who identified the bird as this species and stated that the subspecies could not be ascertained by this head and foot. Dr. Wetmore retained the remains, which have been assigned No. 431142 in the Division of Birds, United States National Museum. This specimen appears to be the first record in Florida and the first south of Long Island on the Atlantic Coast.—H. P. LANGRIDGE, 1421 W. Lantana Avenue, Lantana, Florida.

Northern Waterthrush Returning to Same Winter Quarters in Successive Winters.—In the course of trapping and banding resident forest birds in the Northern Range of Trinidad, we have caught a small number of winter visitors and have banded them with U.S. Fish and Wildlife Service bands. In the winter season 1958–1959 we banded four Northern Waterthrushes (*Seiurus noveboracensis*). One of these (band No. 61-70604), caught on 10 December 1958, was recaptured on 23 December 1959, in a mist net in the identical position in which it had been caught the year before. Wing length and weight were recorded as 74 mm., 15 gm., on the first occasion and 73 mm., 15 gm., on the second occasion.

Northern Waterthrushes arrive in Trinidad in September and leave in April. They are probably fairly sedentary when they have settled down; we have had two cases of recaptures in the same winter, at intervals of 53 and 136 days. They live solitarily, mainly along streams. We have no evidence that they defend territories, but they may well do so as such observations are difficult to make in the forests in which they live. A bird was heard singing once, on 12 April.

Wing lengths of birds trapped in the Northern Range of Trinidad range from 73 to 79 mm. Weights range from 14.5 to 18 gm. (mean of 12, 16.2 gm.), but one bird, trapped on 17 October 1958, on Chacachacare, an arid island off the northwest corner of Trinidad, and obviously newly arrived from the north, weighed only 13 gm.

As far as we know, no northern migrant wintering in the tropics has up until now been proved by banding to return to the same wintering area in successive years, although from their known navigational ability it might have been guessed that they do so. Recoveries of bands from the tropics are few and are almost

always associated with the death of the bird.—D. W. SNOW and B. K. SNOW, *New York Zoological Society's Tropical Field Station, Simla, Arima Valley, Trinidad, West Indies.*

Arenaria interpres interpres in Florida.—On 8 June 1959 the authors collected a female Ruddy Turnstone at Shell Point, Wakulla County, Florida, as a routine part of a study of boreal-breeding shorebirds present in this area during summer. Examination of the specimen showed it to differ markedly from other turnstones taken during the study by its exceptionally dark back. Comparison with descriptions of the American and European subspecies by Bent (USNM Bull. 146, 1929) and Witherby *et al.* ("Handbook of British Birds," Vol. 4, 1940) indicated that it might be of the European race.

The specimen was later examined by Bernard Feinstein of the United States National Museum and Kenneth C. Parkes of the Carnegie Museum (the authors gratefully acknowledge their generous assistance), both of whom diagnosed it as *A. i. interpres*.

This specimen apparently constitutes the southernmost record of *A. i. interpres* for the eastern coast of the Western Hemisphere. Bent (*op. cit.*, 294) cites a record from Monomoy Island, Massachusetts. A turnstone taken on Dewees Island, South Carolina, in 1918, was reported to be of the European subspecies, but was later reidentified as *A. i. morinella* by Chamberlain (Auk, 53: 441).

The present specimen (No. 2880.2a) has been deposited in the museum of the Florida State University, Tallahassee, Florida.—HORACE LOFTIN, Department of Biological Sciences, Florida State University, Tallahassee, Florida, and STORRS OLSON, Tallahassee, Florida.

Storm Damage and Renesting Behavior by the Chimney Swift.—Nearly every year that Chimney Swifts (*Chaetura pelasgica*) have nested in air shafts on the buildings of Kent State University, Kent, Ohio, a few nests have been destroyed by storm damage before nesting was completed. Details of certain such accidents have been published by the writer (Auk, 69: 289-293, 1952). In the season of 1959 storm damage was unusually severe, and in addition to the usual behavior of Chimney Swifts when such accidents occur, two pairs renested following the loss of the original nest. In another case, a nest fell from the wall for reasons not known, and it, too, was replaced by another nest. These replacements were among the few such instances observed in this nesting colony under observation annually since 1944. Following is a brief account of each case illustrating the types of behavior among Chimney Swifts when their nests are destroyed.

The same pair of birds that nested together in shaft A1 in 1958 returned to that shaft in the spring of 1959. They began nest construction on 20 May, and the nest was completed four days later. A visiting bird joined the pair at this time and remained with them for most of the season. The first egg was laid on 27 May and was followed by three others two days apart. A fifth egg was discovered on 7 June. All three birds took turns incubating the eggs, but the parents much more so than the visitor. On 21 June the first egg hatched. Within a week three others had hatched. On 5 July a heavy rainstorm washed the nest from the wall. Three of the nestlings survived the fall, and the parent birds with their seasonal visitor continued to feed and care for them. Gradually they worked their way up the wall over a distance of some 41 feet and finally arrived at about the level where the nest had been attached, 7.5 feet from the top. Two of the three juveniles were captured for banding.

Two Swifts, which had not nested previously on the campus, took up residence that year in shaft C1. Nest building began 8 June. The first egg was laid 21 June, and two more were laid at intervals of two days. Some time later a fourth egg was observed on the nest, which was 14 feet down on the west wall. On 23 July, when the nestlings were in blue pin feathers, the nest fell from the wall. Only one of the nestlings survived. This one was tended by the parent birds, but the nest was not replaced.

The male Swift that nested in shaft A5 in 1958 returned to the same shaft for nesting in 1959, but with a new female to replace his former mate. Nest building began 3 June on the north wall, but progress was slow and the foundation was never completed. On 8 June the pair moved to the south wall and began a new nest foundation, 19.7 feet down in the shaft. This was the first time the writer observed relocation of a nest after the original foundation was laid. Three eggs were laid before the storm on 22 June weakened the nest. The following day the male was observed repairing it. Three nestlings with developing blue pin feathers were first observed on 15 July. On 18 July a heavy rain destroyed the nest. None of the nestlings survived. In the evening of 20 July the male remained in the nesting shaft alone, while the female joined a group of six others in shaft I3 and was not known to return to her nesting shaft again.

Another pair of Swifts undertook nesting in shaft B1, where the nest was started on 7 June, being placed only 5.5 feet from the top. The first egg was found on 20 June. Before another was laid, a heavy rain on 22 June washed the nest from the wall. That night the male roosted alone in that shaft. In two days the female returned; but while they remained together for some time, no attempt was made to replace the lost nest.

The above four cases are typical of Chimney Swift behavior when the nest is destroyed before the nesting process is completed. The following three cases are unusual in that the nest was replaced immediately following an accident. The pair that nested in shaft E6 from 1956 through 1958 returned to nest there again in 1959. Nest building began 24 May, 17.2 feet from the top and was completed in four days. The first egg was laid on 29 May and was followed by four others at intervals of one or two days. One hatched on 20 June. How many others may have hatched is not known. A heavy rain storm on 25 June washed the nest from the wall. Ordinarily, nests placed as deeply in the air shaft as this one are not destroyed by storms. The mates remained together, although they did not always roost side by side at night time. On 4 July a new nest was constructed on the same wall (north) as before, but this time 25.4 feet from the top. Four eggs were laid, and this nest has remained on the wall until the present time (February 1960).

The male that nested in shaft L3 in 1958 returned to that shaft for nesting in 1959, but obtained a new mate since his former mate failed to return. Nest building began 31 May, 8 feet down on the east wall. This was completed one week later, and the first egg, laid 7 June, was soon followed by three others. A heavy rainstorm on 22 June destroyed the nest. That evening the male roosted on the nest site alone while the female roosted in shaft L1. Then both birds dropped out of sight. On 7 July a nest with one egg was discovered in shaft K7 where the pair from L3 had relocated and renested following the loss of the first nest. The new nest was 24.4 feet down on the south wall, and three nestlings were successfully raised on this second nest. This was the first time that a pair in this colony nested in two shafts during one season.

The same male that nested in shaft Q2 during 1957 and 1958 returned to the same shaft for nesting in 1959, but obtained a new mate to replace his earlier one, which failed to return. The nest was begun on 5 June, 38 feet from the top of the shaft. One egg was laid 10 June. On 20 June, after an absence of nine days, the writer found the nest missing from the wall, and the parent birds were roosting side by side high on the south wall. Nine days later a new nest was made at about the same place as the old one. This was completed on 4 July. The first egg was not laid until five days later. A second egg was laid, and both presumably hatched. Observations were discontinued after 24 July, but the nest was still on the wall on 17 September and remained there through the winter.—RALPH W. DEXTER, Department of Biology, Kent State University, Kent, Ohio.

Heavy Nematode Infestation of White Pelican.—On 10 October 1959 a dead White Pelican (*Pelecanus erythrorhynchos*) was recovered by the writer and Storrs Olson, Tallahassee, Florida, from the northeastern Gulf of Mexico, a mile offshore from Shell Point, Florida, on Apalachee Bay. There were no other pelicans in the vicinity, although 14 were seen the same day at St. Marks lighthouse, about five miles to the east. There were no signs of decomposition. Autopsy performed the next day showed that the skin of the pelican, an adult female, was intact, and that she had not been killed by gunshot. No fat accumulation was seen anywhere, under the skin or in the viscera, and the flight muscles appeared somewhat underdeveloped. The gut was totally empty, except for the presence in the stomach of well over 1,100 nematodes. As a result of this great infestation, the stomach was enlarged, distended, and markedly discolored; numerous small ulcers and damaged areas could be seen in the stomach wall, where some of the nematodes were still attached. The parasites were determined to be a species of *Contracaecum*, probably *C. micropapillatum* Stossich, a common ascaroid found in both White and Brown pelicans (*P. occidentalis*) (York, W. W., and P. A. Mapleson, "The Nematode Parasites of Vertebrates," Blakeston, London, 536 pp., 1926).

The actual cause of death of the pelican was not determined, but it is entirely possible that the extremely heavy nematode infestation might have hastened death, in one or more ways: actual damage to the stomach, blockage of further passage of food, or by weakening the pelican enough so that feeding became difficult. Instances of helminth parasites actually causing the death of their hosts are sufficiently rare that it is felt that the present nematode infestation was only a contributing factor in the death of the pelican.—LARRY C. OGLESBY, Department of Biological Sciences, Florida State University, Tallahassee, Florida.

Ivory-billed Woodhewer Feeds on Mud Flat.—On 27 December 1959, while observing shorebirds on a mud flat about three kilometers by road east of San Blas, Nayarit, México, I saw an Ivory-billed Woodhewer (*Xiphorhynchus flavigaster*) feeding on the same flat. The mangroves that cover much of the coastal plain in this area have been cut down and removed over several acres around the junction of the side road to Matanchen, so that stumps up to six inches high dot the flats. The nearest forest in which woodhewers might be expected to reside is on ridges over half a kilometer to the east.

The woodhewer was pecking at the mud, apparently feeding on the small insects that had attracted the many Audubon's Warblers (*Dendroica auduboni*) and Water Pipits (*Anthus spinolella*) feeding near it. The nearest shorebirds were Semi-

palmated Plovers (*Charadrius semipalmatus*), which were feeding with other shorebirds around shallow pools and tidal channels 15 to 100 meters south of the woodhewer. The latter hopped along in the manner of a flicker (*Colaptes* sp.) feeding on a lawn, but held its body more level and its tail higher than a flicker normally does. When I approached the woodhewer, it moved to a stump and then flew to a telephone pole some 10 meters north, near the main road. Instead of flying to the nearest patch of low mangroves, about 20 meters west, the woodhewer then flew down to the grass and mud flats north of the road and resumed feeding among the stumps.

On the following day another woodhewer was seen in the forested hills about four kilometers northeast of these mud flats. This bird was feeding on the trunks of trees and in bromeliad epiphytes in the way that I have often seen the species feed in British Honduras. In the mangroves 1.1 miles south of these mud flats, W. J. Maher had collected an Ivory-billed Woodhewer (Mus. Vert. Zool. No. 134169) on 27 December 1955. Dickey and van Rossem (The Birds of El Salvador, Zool. Ser., Field Mus. Nat. Hist., 23: 323. 1938) found that *Xiphorhynchus flavigaster* often fed on the ground, but they encountered the species only in forests. If ability to find food during the nonbreeding season in such diverse habitats as mud flats, mangrove swamps, and upland forests is characteristic of the species, it is not surprising that *Xiphorhynchus flavigaster* has a wider distribution in the Mexican lowlands than any other species of woodhewer.—EDWIN WILLIS, *Museum of Vertebrate Zoology, Berkeley, California.*

Occurrence of *Collyriclum faba* in Steller's Jay.—A Steller's Jay (*Cyanocitta stelleri*) was collected by Charles Fred on 1 December 1959 at the base of the Shoemaker Grade on the Grand Ronde River, Asotin County, Washington. The bird was infected with 26 adult *Collyriclum faba* which were in 13 cysts adjacent to the anus. Each cyst contained two flukes and the cluster of cysts presented a tumorlike mass.

The occurrence and distribution of *C. faba* was reviewed by Farmer and Morgan (Auk, 61: 421-426, 1944). They reported that the distribution of the fluke in the United States was limited to the Eastern and North-central areas with no records west of the Great Plains. This appears to be the first record of *C. faba* in the Pacific Northwest and the first record of Steller's Jay serving as a host for this parasite. It is hoped that this report will stimulate collectors to examine the anal region of birds for this interesting fluke and throw more light upon its distribution and life cycle; the latter is still unknown.—C. W. McNEIL, *Washington State University, Pullman, Washington.*

An Avian Air Battle.—An ornithology class observed an unusual air combat between two Sparrow Hawks (*Falco sparverius*) and three Common Crows (*Corvus brachyrhynchos*) about 10 A.M., 15 June 1955, over the Conodoguinet Creek in south-central Pennsylvania. Apparently the conflict had started only a short time before the birds were seen, for they were within a vertical range of two to three times the height of several large sycamore trees; the action ended so high the two species could hardly be distinguished by the naked eye.

The falcons were rather swifter in the diving, at times using even two or three wing strokes at the start of the downward glide to pick up velocity rapidly. In coming out of the dive, both species, using their momentum, shot rapidly upward, wings rigid as in the dive, until their speed was checked to the point that wing

strokes became necessary. In using the velocity attained at the end of a dive to gain a quick start up again, the falcons seemed to move faster and to go higher in the upward glide than the crows. As propulsive flight was assumed, the climb took on a spiral form and was much slower for both species. In the diving, neither species seemed to desire to make a strike, but rather to threaten and frighten.

After watching the action for about a minute with one bird after another, falcon or crow, diving in an attack, then starting to climb again, the observers seated themselves on the roadside. A number of times when one bird had started a dive on a lower enemy, still another bird would be high enough to start an attack on the attacker—thus three birds would be diving at different depths at one time. Meanwhile the general elevation of the action had doubled.

Next a feud seemed to develop between one crow and one falcon. They drifted off to one side, and after a few more passes, withdrew. The remaining falcon and crows moved steadily higher and higher until they appeared quite small. All three adversaries seemed to climb with increasing difficulty, attacks coming at longer intervals as they drifted upward in steep spirals. However, an attack was made whenever one combatant appeared to have an altitudinal advantage. Several times after the battle was at great altitude, one or the other crow seemed about on the point of disengaging, then would swing back in. I have rarely seen crows so high and have never seen an aerial action so prolonged. The contest lasted approximately five minutes. As the crows withdrew, the falcon made a very graceful and speedy glide down toward the sycamores.—THOMAS SMYTH, *State College, Shippensburg, Pennsylvania.*

BOOK REVIEWS

Bent's Life Histories of North American Birds.—Edited by Henry Hill Collins, Jr. 1960. Vol. I, Water Birds, 356 pp.; Vol. II, Land Birds, 374 pp. Harper and Brothers, New York. \$5.95 per volume.—According to the jacket blurb these volumes at last make available to all bird lovers the "essence" of Bent's great work in convenient form, using full excerpts, not condensations. "The editor has generally omitted such technical data of the original as plumages, distribution, field marks, and focused on the more colorful personality of the individual birds, their places in history or in the modern world of men."

The principal contribution of the original volumes consisted of the very sections on "technical data" omitted from the present work. This "abridgement" has simply lifted many paragraphs or sections *in toto*, mainly anecdotes or very general accounts written by Bent or contributed by many of the observers who collaborated with him. The result can in no way be considered "life histories." These volumes are well printed on good paper and handsomely bound. The serious student of ornithology will find little of interest here, although there is much that should appeal to more casual students of the subject. There are no illustrations.—GEORGE E. HUNSON.

Sexual Selection and Species Recognition Marks in Birds.—A. B. Kistyakovskiy. 1958. Kiev State University imeni T. G. Shevchenko. 199 pp. including contents and bibliography, no index, 3 col. pls. and 7 text figs. (In Russian. No summaries.) Paper cover. Four Continent Book Store. New York. \$.75.—The paper cover of this book bears an attractive water color of two ruffs in display; the three plates are similar decorative additions comparing species recognition marks in 18 ducks, 16 buntings (*Emberiza*), and 12 weaver finches. In these respects, as in price, quality of paper, and typography, the book resembles an American paperback intended to reach a very large public. It is somewhat surprising, therefore, to discover that it contains a fairly technical discussion based upon a more or less brief review of about 87 American and British, 60 Russian, 48 German, and half a dozen other titles germane to the subject in hand.

A brief historical account of the development of the theory of sexual selection is followed by a series of chapters dealing separately with: general characteristics of the functions of recognition marks; physiological and nervous implications; description of recognition marks in general; species recognition marks in relation to ontogenesis; geographic variation; species formation; recognition marks in other classes (reptiles, insects, amphibians, and mammals); and a chapter divided into separate sections dealing with color and form, size, voice, odor, polymorphism, and territory.

In his introductory paragraphs and from time to time in the text, the author summarizes his position that contemporary research validates the general Darwinian theory of sexual selection although modifying it with respect to details. He states (p. 37) ". . . it must be stressed that the recognition factor of species markings plus the recently established fact that external appearance and actions of the male influence ovigenesis in the female both supplement the theory of sexual selection but do not replace it. It is furthermore necessary (in the light of newly acquired data) to broaden our concept of the sphere of sexual selection, viewing it as an outcome not only of intraspecific but also interspecific relations, not as an independent, narrow aspect of selection, but as one of the forms of natural selection."

The American student will be interested in many of Kistyakovskiy's examples drawn from research in the USSR. For instance, in emphasizing the role of size as a species recognition mark, the disposition of three races of great tit (*Parus major major*, *P. m. wladivostokensis*, and *P. m. bocharensis*) is described. The typical form ranges from Western Europe to the Pacific, north of about 50° N. Lat.; *P. m. bocharensis* is a geographic race in the Central-Asiatic (Aral-Balkhash) area; and *P. m. wladivostokensis* occurs in North China and Maritime Siberia. Separated by the Gobi, *wladivostokensis* and *bocharensis* do not come in contact, but both are in contact with the typical form to the north. The Far Eastern race is transitional in color between the typical and Central-Asiatic forms, but is closer in this respect to the typical form. The voice of *P. m. wladivostokensis* does not differ from that of the typical form, but it is distinctly smaller than either *P. m. major* or *P. m. bocharensis*. However, ". . . while *P. m. bocharensis* crosses freely with *P. m. major*, from which it differs distinctly in color, the Far Eastern form conducts itself exactly as if it were a 'good species' in the zone of contact with the typical form, showing no inclination to hybridize with the form which is similar to it in all respects except that of size."

Kistyakovskiy is clearly familiar with Western trends in the study of evolution. It appears to this reviewer that no basic differences in attitude are expressed although one can find instances of where he rejects interpretations which seem to be gaining acceptance among British and American ornithologists. He takes issue, for example, with Julian Huxley's inclusion of certain actions plus markings under the term "threatening display." Kistyakovskiy states the following (p. 72): "Threatening postures and sounds have nothing in common with display and to apply to them the term: 'threatening display' ['ugrozhayushcheye tokovaniye'] is of course completely incorrect." Although English *threat* and Russian *ugroza* are reasonably equivalent terms, *display* and *tokovaniye* are not precisely congruent. One might well expect linguistic misunderstanding to creep into an American interpretation of a Russian interpretation of Huxley's sophisticated English. However, Kistyakovskiy's views are neither expressly nor inadvertently shrouded by language subtleties. He explains that: (1) Intensification of display on the part of a paired bird when a rival approaches results from the loss-of-mate-threat posed by the rival and a consequent strengthening of the courtship factors that bind the female to the male. (2) Display markings that are completely familiar to all the members of a flock (male and female) could not suddenly be converted into a threat; for a threat, unfamiliar patterns are required. (3) On the approach of a strange male to the vicinity of a paired male the characteristic courtship sounds and actions of the paired male are changed to similar but not identical threat behavior; or else threat behavior is alternated with courtship behavior.

Kistyakovskiy's discussion does not include sections on the roles played by genetic mutation or differential reproduction in the process of selection. His book contains a great deal of typographical and editorial error. These deficiencies, however, are not grievous enough to preclude it from being used as an instrument to promote additional East-West cooperative thought on the as yet none too well understood functions of selection in general.—D. G. NICHOLS.

The Avian Embryo.—Alexis L. Romanoff. 1960. The Macmillan Company, New York. xvii + 1305 pp., 427 figs. \$35.—The accelerated rate of activity in the present era of scientific investigation, together with the staggering cost of publication of large volumes in limited editions, has exerted a seriously depressing

effect on the production of scholarly encyclopedic monographs. This tendency unfortunately comes at a time of increasing need for such publications in most fields of science. The appearance of Professor Romanoff's monumental treatise, a complement to his earlier "The Avian Embryo," is consequently an encouraging event. Specifically, this monograph is of singular importance to many aspects of biology because of the extensive use and importance of avian embryos as experimental animals. This wide use of the avian embryo in so many kinds of investigations has made the preparation of this volume a formidable task. A critical examination of more than 7,000 original publications, about two-thirds of which were in languages other than English, was necessary. The importance of this treatise is further emphasized when one recalls that more than five decades have passed since the publication of O. Hertwig's "Handbuch der vergleichenden und experimentellen Entwicklungslehre der Wirbeltiere" and Frank R. Lillie's "The Development of the Chick," and even three decades since Joseph Needham's monumental "Chemical Embryology."

After three initial chapters dealing with the reproductive cells, fertilization and fertility, and early morphogenesis, the remainder of the book consists of chapters devoted to the individual organ systems. Although the primary aspect is that of the classical embryology, there is extensive use of the enormous literature of experimental embryology, and considerable use of physiological and biochemical literature. It is patently clear that the production of this treatise has been possible only with strenuous, and doubtless painful, selection and condensation of a vast quantity of information of variable quality. This has been effected within an admirably integrative structure. Admitted there are instances, perhaps many, where there can be disagreement with the selection and interpretation. For example, although I would not disagree extensively with the author's selection of information influencing gametogenesis in birds, I feel that there is sufficient other information now at hand to allow a more satisfying integration. However, this criticism becomes essentially trivial and quite unjust in light of the enormity of the task of effecting a selection and integration of so many facets of this complex field.

Ornithologists will quickly recognize that most of this book is based on the embryo of the domestic fowl. This, of course, represents no basic choice of the author, who, indeed, has injected comparisons with other species wherever possible. It simply reflects the overwhelming selection of the embryo of this species by investigators. Professor Romanoff's study is thus replete with implicit challenges for investigations in comparative avian embryology. It is to be hoped that these challenges will prove to be among the many important functions of this outstanding monograph.—DONALD S. FARNER.

A Field Guide to the Birds of Texas.—Roger Tory Peterson. 1960. Published for the Texas Game and Fish Commission by Houghton Mifflin Co., Boston. xxx + 304 pp., 60 pls. (36 in full color), and numerous line illustrations (including 13 pp. of silhouettes). \$3.00. (Obtainable only from the Texas Game and Fish Commission, Walton Building, Austin, Texas; send check or money order; no C.O.D.)—The growth of ornithology in Texas, both as an area of biological research and as an educational and recreational activity, has long been hampered by the lack of an authoritative and comprehensive summary of distributional data and a convenient one-volume field guide. With a view to correcting this situation, five years ago the Texas Game and Fish Commission asked Peterson to prepare

the present book as part of a larger plan of the Commission to publish a series of works dealing with the wildlife resources of Texas. Under terms of an arrangement with the publisher, the Commission, which appropriated \$60,000 for the project, has exclusive control of distribution of the volume for a three-year period. Despite the fact that the new field guide has not been advertised, even in Texas, some 7,500 copies were sold by the end of April, two and one-half months after the publication date.

Both in format and in style, the Texas field guide is identical with Peterson's familiar eastern and western field guides. It is a pleasure to report that it has been prepared with the care and attention to detail that characterizes these companion volumes. Two-thirds of the 60 plates are new (some are to be used in a forthcoming new edition of the western field guide), and the other plates have already appeared in the eastern guide. The new plates, it may be noted, are distinctly superior to those in the western guide.

A total of 487 species are recorded as occurring regularly in Texas and are treated in full in the main body of the text. An additional 55 "accidentals" (species recorded in Texas less than six times) are briefly considered in Appendix I; 27 of the "accidentals" are regarded as "hypothetical" since their occurrence in the state is not substantiated by "a specimen, capture, or good photography." Fifteen extinct or unsuccessfully introduced species, together with several living species that no longer range into Texas, are treated in Appendix II. The total of 542 species recorded in Texas (excluding those listed in Appendix II) are, as Peterson notes, "three-quarters of all the species known to occur between Mexico and the Canadian border and very nearly as many as have been listed for all Europe west of the iron curtain."

This reviewer wishes to emphasize the importance of this new work, not only as an excellent and long-awaited field guide, but as the first book dealing in a comprehensive way with any aspect of the avifauna of Texas. Much of the data on distribution, obtained from the standard sources, by careful sifting of records from a variety of unpublished county check-lists and field cards, and from a group of 30 "key people" in the state who examined a draft of the manuscript, were hitherto unavailable in published form. Peterson's new book will be for many years to come the primary source of information on the distribution and status of birds in Texas. Its publication cannot fail to provide tremendous impetus to the development of ornithology in this state.—ROBERT K. SELANDER.

Diseases of Poultry.—Fourth Edition. Edited by H. E. Biester and L. H. Schwarte. 1959. Iowa State University Press, Ames, Iowa. xiii + 1103 pp. 402 figs.—The new edition of this standard treatise on poultry diseases contains contributions by 33 authors. Although its primary concern is the domestic fowl, the book contains much about other domestic species and considerable that is generally applicable to birds maintained in captivity. As in the previous edition there are 41 chapters, some of which have been extensively revised whereas others have been altered only slightly. The new edition has been set with two columns per page and with slightly smaller type with some economy of space. Among the chapters that should be most interesting and useful to the ornithologist are those on nutrition (Chapters 6 and 7), pullorum disease, paratyphoid infections, fowl typhoid, fowl cholera, tuberculosis, ornithosis, fowl pox, fungous diseases, fowl plague, and to a lesser extent those on external and internal parasites.—DONALD S. FARNER.

The Mystery of the Flamingos.—Leslie Brown. 1960. Country Life Limited, London. 116 pp., 32 figs. 25s.—For six years Leslie Brown dedicated all his leave and spare time studying the flamingos of East Africa. When he initiated his ornithological explorations, there were about three million lesser flamingos and something like fifty thousand greater flamingos on the alkaline lakes of the Rift Floor in Kenya; but no one had observed a nesting colony. Since Brown was particularly anxious to study breeding and nesting of flamingos, he began searching for a nesting colony. Foot safaris led him to many remote and inhospitable regions in Kenya and Tanganyika. In writing about these safaris, Brown reveals the hardship and pleasure, the bizarre and beauty, of African life in a realistic manner. In the Rift Valley he encountered nomadic tribes unwilling to assist any European. They, like their overabundant herds of cattle, were thirsting and starving on overstocked ranges. Adhering to age-old tribal customs, they refused to sell their surplus stock, and hence their herds were ultimately reduced by drought and starvation. Yet in this bleak country of heat, dust, dying cattle, and millions of flies and mosquitoes, there are remote areas rich in wildlife where Brown realized an indescribable sensation of peace and escape from the banalities of the world. His safaris continued despite numerous hardships, disappointments, and perils. He camped near clear streams, slugged through soft sucking mud around soda lakes, struggled through slimy lake water unbelievably foul with blue-green algae and leprous floats of crystalline soda.

Brown's determined efforts were eventually rewarded; in 1957 he located and studied a breeding colony of lesser flamingos on Lake Natron. Here he obtained observations and took many pictures of the breeding, displaying, feeding, hatching, movements, molting, and concentrations of flamingos. I was impressed most by the: (1) possible social significance (mutual stimulation) that colony size or flamingo numbers might exert on the success of nesting, and (2) observations of mortality to flamingo populations. Most readers will enjoy Brown's style of writing; it is pleasing, easy to read, and interesting. In the full moon "faintly and exquisitely pink, they have a strange aura of radiance" (p. 16); in territorial display the "erected plumes make them look like huge pink feather dusters" or "like gigantic chrysanthemums" (p. 33). Although much remains to be learned about flamingos in East Africa, Brown's work provides a basis for further studies of this bird, and it should stimulate research on other aspects of wildlife in Africa. "In Africa discovery, in the true sense, still lies upon the doorstep, at least for those interested in natural history" (p. 9).—IRVEN O. BUSS.

Ekologiya Zverey i Ptits Lesostepnikh Dubrav. [Ecology of Birds and Mammals of the Forest-Steppe Oak Woods.]—G. A. Novikov. 1959. Izdat. Leningrad Univ., Leningrad. 351 pp., illus. R 23, 60 kop.—Oak woods extend over some thousand kilometers in the forest-steppe from southwestern Ukraine northeastward into the Urals. These are isle-like woods, surrounded by steppe, fields, and meadows. The animal populations have been since the Pleistocene more or less isolated. Due to the geographical site, favorable climatic conditions, food supply, and wide edge, there is in these woods a high concentration of both birds and mammals. Novikov lists 65 species of mammals and 139 species of birds. The natural density of birds varies from 8 to 84 birds per hectare, according to the structure and age of the woods. On the basis of the investigation of the distribution of over 3,000 nests in the particular tree species, it has been found that the oak is the most preferred tree species for nesting. Most of this book is

devoted to the trophic relations of birds and mammals: feeding on seeds and fruits of the woody plants, other plants, on lichens, moss, fungi, and the importance of water is stressed. The insect food—mainly forest pests—of birds is broadly discussed, and a valuable account on feeding of birds on ants is given. About one third of the birds considered feed on about 20 species of ants. In some woods by means of nest boxes the density of birds increased from 32 to 252 pairs of birds per hectare. An account of yearly, seasonal, and daily activity, as well as phenology, is given, and the succession of bird and mammal communities from cut-over areas to old stands of woods is discussed. Due to the wide extension of oak woods along the geographical longitude, they are extremely favorable for the study of geographical variation of the communities and populations. There is a selected literature of 20 pages.

The work is important for European ecology, and with its general conclusions, amount of material, and comparative value it is of interest outside the Old World, too.—F. J. TURCEK.

RECENT LITERATURE
EDITED BY FRANK McKINNEY

ANATOMY AND EMBRYOLOGY

BORODULINA, T. L. 1960. [Morphological peculiarities of the attachment of the feathers in a bird's wing.] Zool. Zh., **39**: 124-135.—Birds that to an important extent depend upon their long wings to obtain food have prolonged calami proximally, narrow inner wings (secondaries), and well-developed wing-coverts. Birds that do not use their powers of flight for food gathering have short wings, short calami, and less-developed coverts. In the first group, the marginal ligament functions in the partial turning of the secondaries along their longitudinal axis, and during the upward movement of the wing, this allows air to circulate between the feathers and reduces air resistance. The paper reinforces the old theory of Precht of the structure of wings. There are fine drawings and photographs. (In Russian; English summary.)—F. J. T.

SENO, T. and S. SARO. 1959. A chimaeric duck with the head of a chick. Nature, **184**: B.A. 78-79.—A duck embryo with a grafted chick's head survived through 28 days of incubation (26 days after grafting).—H. C. S.

BEHAVIOR

BAERENDS, G. P. 1959. The ethological analysis of incubation behaviour. Ibis, **101**: 357-368.—Information on behavioral mechanisms associated with securing conditions suitable for normal development of eggs is summarized. These mechanisms include incubation, egg retrieving, settling, quivering, ruffling, and preening. The activation, inhibition, and interrelationships of these with other internal and external factors are discussed.—J. W. H.

BAKUS, G. J. 1959. Territoriality, movements, and population density of the Dipper in Montana. Condor, **61**: 410-425.—Study of *Cinclus mexicanus* with color-banded birds mist-netted along 13 miles of stream. Strong winter territorial behavior from November-February; no territory during pairing. Pre-nesting density about one bird for 0.48 miles of stream.—R. E. P.

CRAMP, S. 1958. Territorial and other behaviour of the Woodpigeon. Bird Study, **5**: 55-66.—Observations made in central London on territory, pair formation, choice of nest site, and copulation in *Columba palumbus*. Territory is thought to function in providing a safe place where pair-strengthening displays and copulation can take place without interference from other Woodpigeons.—F. M.

DAVIS, D. E. 1959. Territorial rank in Starlings. Animal Behavior, **7**: 214-221.—Territorial behavior and social rank are considered in terms of density. Captive Starlings exhibit social rank, while in the wild this can resemble territorial behavior as the subordinate bird is present only temporarily. It is suggested that the Starling territory is really a special case of social rank in which there are no permanent subordinate individuals.—R. I. S.

FOREMAN, D. and W. C. ALLEE. 1959. A correlation between posture stance and outcome in paired contests of domestic hens. Animal Behavior, **7**: 180-188.

GAUNT, A. S. 1959. Behavior in the Purple Martin. Kansas Orn. Soc. Bull. **10**: 14-16.—Data, chiefly ethological, on *Progne subis* in Kansas.—E. E.

HESS, E. H. 1959. Imprinting. Science, **130**: 133-141.—In Mallard ducklings imprinting is most effective at an age of 13-16 hours and becomes difficult after

29-32 hours. Ducklings imprinted in the laboratory to follow a decoy later preferred the decoy to a mallard duck accompanied by ducklings. Chicks imprinted by following spheres of various colors later followed blue spheres the farthest and white the shortest distance. Spheres without mock heads, wings, and tails were more efficient in eliciting the following reaction than spheres with them. The strength of imprinting was found to be proportional to the effort expended by the animal during imprinting. The critical period is reported to be determined at its start by the time necessary for the development of the required motor ability and at its conclusion by the appearance of fear. Use of the tranquilizing drug chlorpromazine permitted a higher degree of imprinting in animals 24 hours of age than in controls; presumably through the inhibition of fear. Imprintability has a genetic basis. Some species proved more imprintable than others. Sheep and guinea pigs were successfully imprinted. Imprinting is stated to be one rigid form of learning that precedes associative learning.—J. C. H.

HINDE, R. A. 1959. Motivation. *Ibis*, **101**: 353-357.—It is unlikely that a single drive can be used with reference to a number of different characteristics of behavior with the implication that all of these depend on one aspect of the responsible physiological mechanism. Unitary concepts of drive, even when used solely with reference to changes in responsiveness to a constant stimulus, have limited value. There is no need to postulate a drive that "energizes" behavior. An important reevaluation.—J. W. H.

HINDE, R. A. 1959. Some factors influencing sexual and aggressive behaviour in male Chaffinches. *Bird Study*, **6**: 112-122.—Experiments with caged birds indicated many factors: hormones, the immediate external stimulus, the general external situation (influenced by the presence of a dominant male or the possession of a territory), fluctuations in internal conditions lasting minutes or hours, short-term fluctuations in responsiveness consequent upon performance, previous experience, inhibitory effects between sexual and aggressive behavior, and individual differences in responsiveness.—F. M.

HINDE, R. A. and R. P. WARREN. 1959. The effect of nest building on later reproductive behavior in domesticated Canaries. *Animal Behavior*, **7**: 35-41.—The effects of various degrees of deprivation of nest material and nest site are examined. The female Canary may lay eggs without performing earlier reproductive activities, but laying is delayed and clutch size is abnormal.—R. I. S.

JOHNSTON, R. F. 1960. Behavior of the Inca Dove. *Condor*, **62**: 7-24.—Description of notes, winter and breeding activities, territory, and aggression with discussion of ethological implications.—R. E. P.

KILHAM, L. 1959. Behavior and method of communication of Pileated Woodpeckers. *Condor*, **61**: 377-387.—An account of observations in Maryland and Florida of vocalizations, displays, territorial and nesting behavior.—R. E. P.

KURODA, N. 1960. The flocking behaviour of wintering Brown-eared Bulbuls and their spring departure. *Tori*, **15**: 227-231.—Studies of intraflock relationships, correlation of spring break-up of flocks with food supply and temperature, and *Zugunruhe* in *Hypsipetes amaurotis*. (In Japanese; diagrams and summary in English.)—K. C. P.

LORENZ, K. Z. 1959. The evolution of behavior. *Scientific American*, **199**: 67-78.—The inheritance of instincts and patterns of behavior is discussed. Behavior as well as morphology is a useful basis for the determination of phylogenetic relationships. The stability of the more deep-seated behavior traits is

- compared with that of the skeleton in terms of rate of evolutionary change. Examples of the action of selection on traits of behavior are taken from studies of gulls, cichlid fishes, and surface-feeding ducks.—J. C. H.
- MACKENZIE, J. M. D. 1959. Roosting of Treecreepers. *Bird Study*, **6**: 8-14.—*Certhia familiaris* excavates roosting holes in Wellingtonia bark wherever these trees are found in Great Britain.—F. M.
- MARLER, P. and D. ISAAC. 1960. Physical analysis of a simple bird song as exemplified by the Chipping Sparrow. *Condor*, **62**: 124-135.—A study of the physical characteristics of Chipping Sparrow songs utilizing tape recorder for recording and a Sona-graph for analysis. Data will serve as a basis for accurate description of song for comparison of different individuals, and as a basis for study of more complex songs of other species.—R. E. P.
- MARSHALL, J. F., JR. 1960. Interrelations of Abert and Brown Towhees. *Condor*, **62**: 49-64.—Detailed field studies of *Pipilo aberti* and *Pipilo fuscus mesoleucus* in areas of overlap in Arizona and of *fuscus* in California. Little antagonism between species was seen. Pair formation preceded song period in both species, so isolating mechanisms must be visual and in call notes. Includes detailed discussion.—R. E. P.
- PETTERSSON, M. 1959. Diffusion of a new habit among greenfinches. *Nature*, **184**: 649-650.—The geographical spread of the Greenfinch's habit of stripping the shrub, *Daphne mezereum*.—H. C. S.
- SALZEN, E. A. and W. SLUCKIN. 1959. The incidence of the following response and the duration of responsiveness in domestic fowl. *Animal Behavior*, **7**: 172-179.
- SCHEIN, M. W. and E. B. HALE. 1959. The effect of early social experience on male sexual behavior of androgen injected turkeys. *Animal Behavior*, **7**: 189-200.
- SIMMONS, K. E. L. 1959. Anting movements and their relationship to certain other behaviour patterns. *Ibis*, **101**: 368-372.—The author studied anting in various European passerine birds and concludes that most birds deliberately anoint only the wings and incidentally the tail (exceptions occurring in the corvids and icterids). He discusses the relationships of anting to other behavior phenomena especially feather-maintenance acts and concludes that passive anting may be related to and perhaps derived from high-intensity sunning. Active anting may in turn be derived from preening, especially preen-oiling with which it shares movements. Finally, formic acid may supplement the natural preen-oil and may be effective in combating parasites.—J. W. H.
- STEINBACHER, J. 1959. Der Flug der Vögel. *Natur und Volk*, **89** (9/10): 309-325.—A well-illustrated general account of the mechanism of flight in birds. Part of a series of articles published in the same double issue of this journal on flight in prehistoric and modern animals.—E. E.
- THORPE, W. H. 1959. Learning. *Ibis*, **101**: 337-353.—The author discusses recent advances in the study of learning in birds and relates these to our knowledge of "individually modifiable" behavior. Topics included are habituation, response-waning, internal inhibition, trial-and-error learning, "instrumental" conditioning, imprinting, social facilitation (including its evolutionary importance).—J. W. H.
- TINBERGEN, N. 1959. Behaviour, systematics, and natural selection. *Ibis*, **101**: 318-330.—The relationship of behavior to systematics and evolutionary studies

- is discussed in terms of taxonomic use of behavioral characters and phylogenetic interpretation of behavioral data.—J. W. H.
- WARREN, R. P. and R. A. HINDE. 1959. The effect of oestrogen and progesterone on the nest-building of domesticated Canaries. *Animal Behavior*, 7: 209-213.—Large doses of estrogen induced nest-building behavior in Canaries during the nonbreeding season. Progesterone alone, in the dosage used, did not. Progesterone used in combination with estrogen did not augment or suppress the action of estrogen.—R. I. S.
- WILLIS, E. 1960. Voice, courtship, and territorial behavior of Ant-Tanagers in British Honduras. *Condor*, 62: 73-87.—Description of behavior, especially vocal and territorial, of two sympatric species with discussion of isolating mechanisms. Includes audio spectrographs.—R. E. P.

DISEASES AND PARASITES

- GEORGE, R. S. 1959. Fleas from nests of the Pied Flycatcher and other species in the Forest of Dean. *Bird Study*, 6: 132-136.
- GROUPE, V. and F. J. RAUSCHER. 1959. Factors contributing to production of "virus-free" tumors in turkeys by Rous sarcoma virus. *Science*, 129: 1022-1023.
- JENNINGS, A. R. 1959. Diseases of wild birds, fifth report. *Bird Study*, 6: 19-22.
- LAKE, F. B. 1958. Treatment of sick and wounded birds. *Bird Study*, 5: 66-74.
- PRIER, J. E. and R. SULLIVAN. 1959. Development of chick embryo heart cell for the cultivation of poliovirus. *Science*, 129: 1025-1026.

DISTRIBUTION AND ANNOTATED LISTS

- BAGENAL, T. B. and D. E. BAIRD. 1959. The birds of North Rona in 1958, with notes on *Sula Sgeir*. *Bird Study*, 6: 153-174.—Studies on two islands of the Outer Hebrides.—F. M.
- DAVIS, T. A. W. 1958. The breeding distribution of the Great Black-backed Gull in England and Wales in 1956. *Bird Study*, 5: 191-215.—Detailed distribution of *Larus marinus* with data on habitat, nest sites, nesting associations, food, and predators.—F. M.
- EDWARDS, E. P. and R. S. TASHIAN. 1959. Avifauna of the Catemac Basin of southern Veracruz, Mexico. *Condor*, 61: 325-337.—General description of climate and habitats, some notes, and a systematic list.—R. E. P.
- GULLION, G. W., W. M. PULICH, and F. G. EVENDEN. 1959. Notes on the occurrence of birds in southern Nevada. *Condor*, 61: 278-297.—Annotated list of birds observed during several years of field studies.—R. E. P.
- HAFER, J. 1959. Notas sobre las aves de la región de Urabá. *Lozania*, 12: 1-49.—Report on a collection of 175 species in the Gulf of Urabá region, northwestern Colombia; the ranges of a number of species are extended westward, including *Chama chavaria* and *Gampsonyx*. Interesting faunal discussion, with maps. (In Spanish; short English summary.)—E. E.
- LEHMANN, F. C. V. 1959. Observations on the Cattle Egret in Colombia. *Condor*, 61: 265-269.—Brief description of first breeding colonies for Colombia.—R. E. P.
- MAHER, W. J. 1959. Habitat distribution of birds breeding along the upper Koaik River, northern Alaska. *Condor*, 61: 351-368.

- PHELPS, W. H. and W. H. PHELPS, JR. 1959. Las aves de la Isla La Orchila. Bol. Soc. Venez. Cien. Nat., **93**: 252-266.—An account in Spanish of the 39 species of birds recorded on La Orchila, a Caribbean island off Venezuela. Data on migrants; *Sterna f. fuscata* and *Anous s. stolidus* breed there, and *Phoenicopterus ruber* did so until 1952.—E. E.
- PHELPS, W. H. and W. H. PHELPS, JR. 1959. La nidificacion de las aves marinas en el Archipiélago de los Roques. Bol. Soc. Venez. Cien. Nat., **94**: 325-336. Addenda page.—The nesting of marine birds in Los Roques, a group of Venezuelan islands in the Caribbean. Fourteen species are recorded definitely nesting, including such northern forms as *Larus atricilla*, *Sterna h. hirundo*, *S. d. dougalii*, *S. minuta antillarum*.—E. E.
- RAND, R. W. 1959. The biology of guano-producing sea-birds. The distribution, abundance and feeding habits of the Cape Gannet, *Morus capensis*, off the southwestern coast of the Cape Province. Div. Fisheries Investig. Rep., no. **39**: 1-36. Dept. Comm. and Ind., Pretoria, Union of South Africa.
- ROUX, F. 1959. Quelques données sur les anatides et charadriides paléarctiques hivernant dans la basse vallée du Sénégal et sur leur écologie. La Terre et la Vie, **106**: 315-321.—Notes on the wintering of palearctic ducks and waders in the lower Senegal valley.—E. E.
- RUSCHI, A. 1960. Chaves analíticas e artificiais para a determinação dos gêneros e espécies de beija-flores do Brasil, com resumida descrição. Bol. Mus. Biol. "Prof. Mello Leitão", ser. divulgação, no. **1**: 1-28. (Mimeo.)—Artificial keys to the identification of the genera, species (88), and geographic forms (129) of Brazilian hummingbirds, with descriptions of each form, and outline of distribution in Brazil.—E. E.
- RUTTLEDGE, R. F. and R. H. WATT. 1958. The distribution and status of wild geese in Ireland. Bird Study, **5**: 22-33.
- TOSCHI, A. 1959. Contributo alla ornitofauna d'Etiopia. I. Uccelli raccolti ed osservati in Abissinia dal 1939 al 1942. Ric. Zool. Appl. Caccia, **2**, no. 11: 301-412. (Univ. Bologna).—Report on over 800 birds collected in Abyssinia from 1939-1942 by representatives of Bologna University and the former Italian Wildlife Service in that country, including observational data by the author. So little has been published on Ethiopian birds that this report has considerable interest. (In Italian; brief English summary).—E. E.
- WARNER, D. W. and J. R. BEER. 1957. Birds and mammals of the Mesa de San Diego, Puebla, Mexico. Acta Zoologica Mexicana, **2**, no. 4-5: 1-21.—An annotated list of higher vertebrates collected or observed between November 29-December 17, 1951. A number of bird species are added to the recorded avifauna of Puebla. English names are those of Blake's "Birds of Mexico."—E. E.

ECOLOGY AND POPULATION

- BALLANCE, D. K. and G. L. SCOTT. 1959. A winter census on the Wash. Bird Study, **6**: 123-132.—Describes two attempts to estimate the total bird population of the Wash, a large area on the east coast of England.—F. M.
- BOWERS, D. E. 1960. Correlation of variation in the Wrentit with environmental gradients. Condor, **62**: 91-120.—Morphological and color variations were correlated with environmental gradients along a west-east transect in California. Extremities were longer in warmer areas, body mass greater in cooler. Dark forms were less variable than light, reflecting closely variability in habitats utilized by these forms.—R. E. P.

- COTTAM, C. and W. C. GLAZENER. 1959. Late nesting of water birds in south Texas. *Trans. N. Amer. Wildl. Conf.*, **24**: 382-395.—Information on ecology, nest history, nesting abundance, and nesting success gathered during a study of 513 nests of eight species of water birds on the 7,800-acre Welder Wildlife Refuge in south Texas in 1957 and 1958 is given. It is suggested that the importance of environment as a major factor in avian reproduction may not be fully recognized.—S. T. D.
- COULSON, J. C. and E. WHITE. 1959. The post-fledging mortality of the Kittiwake. *Bird Study*, **6**: 97-102.—Annual adult mortality of *Rissa tridactyla* was 12.4 per cent \pm 2.2 per cent at one colony, 7 per cent at another; mortality in first year of life was 21 per cent. Most females breed first when three or four years old.—F. M.
- DIXON, K. L. 1959. Ecological and distributional relations of desert scrub birds of western Texas. *Condor*, **61**: 397-409.—Results of breeding censuses of two plots over two and three years, with description of the habitat. Species composition showed little change, but density fluctuated.—R. E. P.
- HOLLOWAY, P. A. D. 1959. The Great Crested Grebe sample census 1946-1955. *Bird Study*, **6**: 1-7.
- MACARTHUR, R. H. 1960. On the relation between reproductive value and optimal predation. *Proc. Nat. Acad. Sci.*, **46**: 143-145.—Theoretical discussion of population adjustment to insure continuous yield, under planned harvest and through natural predation.
- MURTON, R. K. 1958. The breeding of Woodpigeon populations. *Bird Study*, **5**: 157-183.—Results of an intensive study on *Columba palumbus*. Data on breeding season, clutch and brood size, incubation and nestling period, breeding success, and nesting habitat are presented. Predation on eggs was proportionately higher at higher nesting densities. Territorial behavior is thought to function in limiting nest density rather than in preventing disturbance during copulation. (Letters discussing territory function and whether this species was originally a hole-nester follow in *Bird Study*, **6**: 81-83, 143-144.)—F. M.
- NAKAMURA, T. 1960. Studies on the fluctuation of numbers of Long-tailed Tits. *Tori*, **15**: 201-213.—Analysis of seasonal composition of flocks of *Aegithalos caudatus trivirgatus*. (In Japanese; English summary.)—K. C. P.
- RANWELL, D. S. and B. M. DOWNING. 1959. Brent Goose winter feeding pattern and *Zostera* resources at Scolt Head Island, Norfolk. *Animal Behavior*, **7**: 42-56.
- RAWCLIFFE, C. P. 1958. The Scottish Mute Swan census 1955-56. *Bird Study*, **5**: 45-55.—Census indicated about 500 breeding pairs of *Cygnus olor*; at least 2,500 nonbreeders occurred in herds.—F. M.
- ROGERS, J. P. 1959. Low water and Lesser Scaup reproduction near Erickson, Manitoba. *Trans. N. Amer. Wildl. Conf.*, **24**: 216-224.—On a one-square-mile study area in the pothole habitat of southwestern Manitoba water-level decreases produced a sharp decline in Lesser Scaup production from 1957 to 1958. Indirect effects such as increased predation, grazing, and mowing were coupled with possible direct inhibitory action. Bag-check data from the Delta Marsh are presented showing that more Lesser Scaup were killed in 1958 than any other year for which records were available.—S. T. P.
- YAMASHINA, Y. and S. TAKANO. 1959. Report on the Japanese White Stork census. *Misc. Reports of the Yamashina's Inst. for Ornith. and Zool.*, no. **13**:

1-17 [505-521].—Contribution by the Japanese Association for Bird Preservation to the International Census of the White Stork proposed at the Xth Conference of I.C.B.P., S. Rhodesia, 1957. The Japanese breeding population of *Ciconia ciconia boyciana* has greatly decreased since the early 19th Century. Recommended protective measures are listed. (In Japanese; English summary.)—K. C. P.

YAFFE, W. B. 1959. The birds of high-level woodlands. The winter population. *Bird Study*, **6**: 136-140.

GENERAL BIOLOGY

- BOCHENSKI, Z. 1958. Nesting habits of the Collared Turtle Dove [*Streptopelia decaocto*]. *Bird Study*, **5**: 19-21.
- COULSON, J. C. and E. WHITE. 1958. Observations on the breeding of the Kittiwake. *Bird Study*, **5**: 74-83.—Studies on a colony of *Rissa tridactyla* in Northumberland from 1949 to 1957. Data on incubation and fledging periods, clutch and brood size, breeding success, and growth rate of chicks are presented.—F. M.
- CRIGHTON, M. I. 1959. Attacks by birds on Caddis Flies. *Bird Study*, **6**: 22-25.
- DAVIES, S. J. F. 1958. The breeding of the Meadow Pipit in Swedish Lapland. *Bird Study*, **5**: 184-191.—In comparison with British birds breeding began two months later, clutch size was 1.2 eggs larger; hatching success was higher, but nesting periods were the same.—F. M.
- FRITH, H. J. 1959. Incubator birds. *Scientific American*, **201**: 52-58.—An account of the reproduction of the Megapodiidae. The Mallee Fowl (*Leipoa ocellata*) maintains the nest mound temperature within a range of 90°-95°F, and some individual males keep the temperature within a degree of 92°. The heat comes directly from the sun or is produced by the fermentation of organic matter within the mound. The male may vary its method of temperature control with differences in daily weather. When a heating unit was introduced into the nest mound and the temperature raised, the male took the actions needed to lower the temperature within the mound.—J. C. H.
- HARRISON, C. J. O. and J. FORSTER. 1959. Woodlark territories. *Bird Study*, **6**: 60-68.—Observations on nesting habitat, nest sites, and territorial behavior in *Lullula arborea*.—F. M.
- HINDE, R. A. 1959. Seasonal variations in clutch size and hatching success of domesticated canaries. *Bird Study*, **6**: 15-19.
- KURODA, N. 1959. Field studies on the Grey Starling, *Sturnus cineraceus* Temminck. 2. Breeding biology (part 3). *Misc. Reports of the Yamashina's Inst. for Ornith. and Zool.*, no. 18: 31-48 [535-552].—Covers differences between eggs of 1st and 2nd clutches, incubation period (12 days), growth and development of nestlings, feeding rates correlated with brood size, nest sanitation, etc. (In Japanese; tables and a good summary in English).—K. C. P.
- LACK, D. and E. LACK. 1958. The nesting of the Long-tailed Tit. *Bird Study*, **5**: 1-19.—Observations on roosting, nest sites, laying dates, clutch size, visits to the nest, and nesting losses in *Aegithalos caudatus*. "The frequency with which three or four parents feed one brood is attributed to the high rate of nest destruction, the restricted breeding season and the absence of territorial behaviour."—F. M.
- PITELKA, F. A. 1959. Numbers, breeding schedule, and territoriality in Pectoral Sandpipers of Northern Alaska. *Condor*, **61**: 233-264.—Extensive data on

breeding, habitat, density, and timing with a discussion of field work at Pt. Barrow. The pair bond is short, the males leaving early in summer. Nests are usually away from male territories. Reasons for the early departure of the males are considered, and possible systematic relationships are discussed.—R. E. P.

ROWLEY, J. S., and R. F. ORR. 1960. The nest and eggs of the Slaty Vireo [*Neochloe brevipennis*]. *Condor*, **62**: 88-90.

RYDER, R. A. 1960. The grouse of Colorado. *Colo. Outdoors*, **9**: 1-7.—Distribution, ecology, food habits, reproductive behavior, and management are discussed.

SELANDER, R. K. 1960. Sex ratio of nestlings and clutch size in the Boat-tailed Grackle. *Condor*, **62**: 34-44.—Sex ratio of nestlings of broods of two to five shows no significant deviation from 1:1. Clutch most frequently three or four, rarely two or five.—R. E. P.

TACHIBANA, S. 1960. Notes on some birds breeding on the coast of Oppa Bay, Miyagi. *Tori*, **15**: 195-200.—Notes on breeding biology of *Motacilla alba*, *Nycticorax nycticorax*, *Larus crassirostris*, *Apus pacificus*, and *Cephus carbo*. (In Japanese; English summary.)—K. C. P.

TICKELL, W. L. N. 1960. Chick feeding in the wandering albatross *Diomedea exulans* Linnaeus. *Nature*, **185**: 116-117.—Evidence to indicate that the young are fed during the fledgling period.—H. C. S.

WILLIAMSON, K. 1959. Changes of mating within a colony of Arctic Skuas. *Bird Study*, **6**: 51-60.—Study of *Stercorarius parasiticus* colony at Fair Isle showed that birds breed for the first time at age of three to five years. One-year-old matings are most unstable, probably because many younger birds are late in attaining breeding condition and in returning to colony; early-returning partners of the previous year may have mated already with older birds. Members of old-established pairs are closely synchronized in time of return and attainment of breeding condition; these pairs are seldom broken.—F. M.

EVOLUTION AND GENETICS

BOCK, W. J. 1959. Preadaptation and multiple evolutionary pathways. *Evolution*, **13**: 194-211.—In many groups of birds the articulation between the quadrate bone of the upper jaw and the articular bone of the lower jaw is supplemented by a second articulation in which the medial process of the mandible reaches the basitemporal plate. This secondary articulation forms a medial brace, which functions to prevent disarticulation of the lower jaw in birds such as the Black Skimmer having feeding habits that may cause the mandible to be jerked suddenly backwards. The elongation of the medial process of the mandible during the early stages in its evolution was in response to a selection force for a larger surface for the attachment of stronger jaw muscles. Once the medial process reached the basitemporal plate, it was preadapted for a new function, that of preventing disarticulation, which established a new selection force acting on the process. Differences in the nature of the medial brace in various groups of birds are suggested to be multiple evolutionary pathways of response to the same selection force. By analogy the difference existing in the mammalian jaw hinge may be due to its having evolved several times independently.—J. C. H.

BRILES, C. O., W. H. McGIBBON, and M. R. IRWIN. 1959. Additional alleles affecting red blood cell antigens in the chicken. *Genetics*, **44**: 955-965.

- DANFORTH, C. H. 1958. *Gallus sonnerati* and the domestic fowl. Jour. Heredity, **49**: 167-169.—Reports that *Gallus domesticus* and *G. sonnerati* were successfully crossed and also their hybrid offspring. Some instances of infertility occurred. It is suggested that the relationships of *G. sonnerati*, *G. gallus*, and *G. domesticus* be considered as unsettled.—J. C. H.
- DYRENDAHL, S. 1958. Hereditary tremor in ducks. Jour. Heredity, **49**: 214-216.
- GILMOUR, D. G. 1959. Segregation of genes determining red cell antigens at high levels of inbreeding in chickens. Genetics, **44**: 14-33.
- KOSIN, I. L. and H. ISHIZAKI. 1959. Incidence of sex chromatin in *Gallus domesticus*. Science, **130**: 43-44.
- LANDAUER, W. 1959. A lethal mutation in Dorking fowl. Jour. Heredity, **50**: 137-139.
- MELLEN, W. J. 1959. Hereditary exencephaly in the fowl. Jour. Heredity, **50**: 127-130.
- NEWCOMER, E. H. 1959. Chromosomal translocation in domestic fowl induced by X-rays. Science, **130**: 390-391.
- TAIBEL, A. M. 1957. Analisi di un primo gruppo di fattori del corredo cromosomico della anatra muschiata (*Cairina moschata domestica* L.). Suppl. Ricerca Scientifica, **27**: 1-7.—Analysis of a group of chromosome factors affecting pigmentation in domestic Muscovy Ducks. (In Italian; English, French, and German summaries.)—E. E.
- TAIBEL, A. M. 1958. Un nuovo "fattore di ripartizione", causa della "pezzatura bianca al capo e al terzo superiore del collo", nel corredo cromosomico dell'anatra muschiata (*Cairina moschata domestica* L.). Ann. Sperimentazione Agraria, n.s. **12**, no. 2: 537-553.—A new "color distribution gene" as a cause of white head spotting in the domestic Muscovy. This character occurs in the wild in the related Asiatic *Cairina scutulata*. (In Italian; English summary.)—E. E.
- WERRET, W. F., A. J. CANDY, J. O. L. KING, and P. M. SHEPPARD. 1959. Semialbino: a third sex-linked allelomorph of silver and gold in the fowl. Nature, **184**: 480.

MANAGEMENT AND CONSERVATION

- BASKETT, T. S. and R. E. TOMLINSON. 1959. Bobwhites and benefit payments. Trans. N. Amer. Wildl. Conf., **24**: 289-303.
- DILLON, O. W., JR. 1959. Food habits of wild mallard ducks in three Louisiana Parishes. Trans. N. Amer. Wildl. Conf., **24**: 374-382.—Presents the results of content analysis of 106 gullets and 125 gizzards from mallards taken in Cameron, Acadia, and Vermilion Parishes, Louisiana. Acre for acre, crop residues and weed seeds associated with rice culture produce quality foods far in excess of that produced by natural marsh land. Mallards prefer rice fields for feeding, loafing, and courting, returning to the marshes only because of human disturbance. Preservation and management of both habitat types are essential.—S. T. D.
- FRILEY, C. E., JR. 1959. Controlled goose shooting at Michigan's Swan Creek Highbanks. Trans. N. Amer. Wildl. Conf., **24**: 245-260.
- LYON, J. L. 1959. An evaluation of woody cover plantings as pheasant winter cover. Trans. N. Amer. Wildl. Conf., **24**: 277-289.—Based on the observed reaction of pheasants to winter weather conditions, it was concluded that deciduous woody windbreaks, considered simply as winter cover, probably have no justification in pheasant management.—S. T. D.

- NELSON, U. C. and H. A. HANSEN. 1959. The Cackling Goose—its migration and management. *Trans. N. Amer. Wildl. Conf.*, **24**: 174–187.—Past and present breeding ranges, migration routes, harvest and mortality data, and population estimates are discussed for the Cackling Goose (*Branta canadensis minima*). Banding has shown that only one population exists with a single, restricted breeding ground, the protection of which is one of the primary management needs. Restoration of ancestral breeding areas through the eradication of feral foxes on the Aleutian Islands is also important.—S. T. D.
- SCHIFFER, P. M. 1959. Farming for waterfowl in the Pacific Flyway. *Trans. N. Amer. Wildl. Conf.*, **24**: 238–244.—Describes a program of development and management on 5,100 acres of private land in Oregon and California during 1957 and 1958, which is concerned primarily with the production of waterfowl foods by farming methods.—S. T. D.

MIGRATION AND ORIENTATION

- CORNWALLIS, R. K. 1959. An immigration of winter visitors. *Bird Study*, **6**: 68–72.—Analysis of a heavy movement of Turdidae from southern Sweden and Denmark across southern England to Ireland on November 5–6, 1954. Banding recoveries supplement direct observations to give a clear picture of the migration and its relation to weather conditions.—F. M.
- CORNWALLIS, R. K. 1959. Bird observatories. *Ibis*, **101**: 424–428.—There are now 14 major bird observatories in and around the British Isles (with several less fully equipped or part-time stations). Functions are the visual observation and counting of birds, banding, and critical examination in the hand. Contributions are being made to the study of migration (drift, origins, routes, and destinations of migrants). Measurements, weights, molts, sex and age character of living birds are also being studied. The use of radar and studies of astronavigation are innovations that should increase the contributions of these observatories.—J. W. H.
- GOODACRE, M. J. 1959. The origin of winter visitors to the British Isles. *Bird Study*, **6**: 37–50.—Introduces a series of papers analyzing banding recoveries. Wintering Blackbirds (*Turdus merula*) come from western Europe. In general, those breeding farther north winter farther north in the British Isles; those breeding farther south winter mainly in southern England.—F. M.
- GOODACRE, M. J. 1959. The origin of winter visitors to the British Isles. 2. Chaffinch (*Fringilla coelebs*). *Bird Study*, **6**: 102–108.—Chaffinches breeding in Norway and Sweden winter in the southern parts of the British Isles. Many fly south from Scandinavia in autumn to Belgium and Holland to make the narrow sea crossing into England.—F. M.
- GOODACRE, M. J. 1959. The origin of winter visitors to the British Isles. 3. Brambling (*Fringilla montifringilla*). *Bird Study*, **6**: 108–111.—Banding recoveries suggest that the pattern of autumn migration is similar to that of the Chaffinch.—F. M.
- GOODACRE, M. J. 1959. The origin of winter visitors to the British Isles. 4. Starling (*Sturnus vulgaris*). *Bird Study*, **6**: 180–192.—Analysis of selected banding recoveries shows that Starlings breeding in northern Europe winter mainly in the north of the British Isles. Those breeding farther south winter in the south; the most easterly breeding population winters mainly in the east.—F. M.

- GRAUE, L. C. and J. G. PRATT. 1959. Directional differences in Pigeon homing in Sacramento, California and Cedar Rapids, Iowa. *Animal Behavior*, **7**: 201-208.
- ISHIZAWA, J. 1960. On the distribution and migration of *Locustella o. ochotensis*. *Tori*, **15**: 214-226.—Analysis of 141 specimens picked up at 17 lighthouses since 1924. Subjects covered are migration period and routes, sex ratio, gonadal development, and fat deposition. (In Japanese; English summary.)—K. C. P.
- KOBAYASHI, K. 1959. Notes on Osaka Bay waders. 1-115. Kobe, Japan.—A seven-year study of 39 species of shorebirds at a mudflat at Osaka, Japan. Spring migration lasts about 50 days; autumn migration about 90 days. In spring the peak in number of species comes earlier than the peak in number of individuals; in autumn the opposite is true. Although there is a good English summary, not only the text but also the legends to the tables and graphs are exclusively in Japanese.—E. E.
- KRAMER, G. 1959. Recent experiments on bird orientation. *Ibis*, **101**: 399-416.—Pigeons raised in open aviaries exhibit homeward orientation, but those raised in aviaries with palisades allowing vision only of the sky (down to 30° above horizon) or in aviaries allowing a view of a sector of the north sky and horizon exhibit no such orientation. Orientation is influenced by spatial factors (such as variation due to direction, site of release, site of loft, region). Cloud cover causes decrease in orientational facility. Homing is best in August, poorest in January, there being a consistent parallelity to temperature. Correlation with interdiurnal barometric change is also present.—J. W. H.
- LACK, D. 1958. Swifts over the sea at night. *Bird Study*, **5**: 126-127.
- LACK, D. 1958. Weather movements of swifts 1955-1957. *Bird Study*, **5**: 128-142.—Southward movements in summer, mostly before the time of autumn departure, were observed on the east coast of England. They occurred with a depression centered over northern England or Scotland.—F. M.
- LACK, D. 1959. Migration across the sea. *Ibis*, **101**: 374-399.—The author reviews the literature of trans-sea migration and is concerned mainly with migrations of small passerines for which such journeys seem hazardous. Trans-sea migration is discussed under geographic headings, including the Gulf of Mexico, eastern Pacific, eastern Asia, western Asia, New Zealand, the Mediterranean, western Atlantic, Biscay, and the North Sea. General problems of physiology, weather, long crossings, sea barriers, drift, and navigation are discussed. Some passerines migrate at least 600 miles over sea. Premigratory fat probably is enough for 24-36 hours of flight. Following coast lines may precede and follow trans-sea migration of diurnal migrants and has no guiding significance.—J. W. H.
- SCHMIDT-KOENIG, K. 1960. The sun azimuth compass: one factor in the orientation of homing pigeons. *Science*, **131**: 826-828.—Experiments with free-flying pigeons confirm previous findings from birds in training cages. Pigeons kept in lightproof rooms with artificial day/night cycles offset 6 hours (both plus and minus) and 12 hours from the natural cycle had, on the average, a corresponding deviation in direction of attempted homing when released on sunny days. The fact that a small number of birds homed rapidly and unerringly despite their shifted "biological clocks" suggests that factors additional to the sun azimuth compass are operative.—K. C. P.
- SPENCER, R. 1959. Progress and prospects in ringing. *Ibis*, **101**: 416-424.—The history of bird-banding in Great Britain is outlined with a discussion of recovery

rates (47,465 recoveries through 1957, representing 190 species, but few with more than 25 recoveries), future prospects, and suggestions for improved efficiency in operations. Tables show the species banded, recovery rates, and places of recovery of birds. Too many different banding schemes in Europe, varied conservation practices, and a failure so far to concentrate on the banding of species whose movements are of greatest interest are three principal problems.

—J. W. H.

PHYSIOLOGY

- DAWSON, W. R. and H. B. TORDOFF. 1959. Relation of oxygen consumption to temperature in the Evening Grosbeak. *Condor*, **61**: 388-396.—Measurements give basal metabolic rate (BMR) of 2.5 cc O₂/gm/hour, indicating that the birds do not adapt to cold by increased BMR. Zone of thermoneutrality from 10°C to at least 31°C. Measures of skin temperature suggest the feathers are the major heat conservers.—R. E. P.
- DISNEY, H. J., B. LOFTS, and A. J. MARSHALL. 1959. Duration of the regeneration period of the internal reproductive rhythm in a xerophilous equatorial bird, *Quelea quelea*. *Nature*, **184**: 1659-60.—A brief postnuptial period of sexual regeneration exists.—H. C. S.
- FARNER, D. S. and D. L. SERVENTY. 1959. Body temperature and the ontogeny of thermoregulation in the Slender-billed Shearwater. *Condor*, **61**: 426-433.—Body temperature of active adults was 40-41°C, higher in morning than evening, lowest in incubating birds. Chicks attain thermoregulation in burrow within a few hours of hatching but improve for four days.—R. E. P.
- DE FRANCISCIS, P. and W. LANDAUER. 1959. Combined effects of cortisone and insulin on developing chicken embryos. *Nature*, **184**: 101-103.
- FRINGS, H., A. ANTHONY, and M. W. SCHEIN. 1958. Salt excretion by nasal gland of Laysan and Black-footed Albatrosses. *Science*, **128**: 1572.
- FRINGS, H. and M. FRINGS. 1959. Observations on salt balance and behavior of Laysan and Black-footed Albatrosses in captivity. *Condor*, **61**: 305-314.—Successfully maintained these species by providing only sea water for drinking and supplementing this with more salt.—R. E. P.
- HARTMAN, F. A. and K. A. BROWNELL. 1959. Liver lipids in hummingbirds. *Condor*, **61**: 270-277.—Liver weights and lipid contents of several species of hummingbirds were significantly greater after noon than before. The same held for many other species of insectivorous birds, but lipid levels were significantly lower in them than in hummingbirds.—R. E. P.
- HÖHN, E. O. 1959. Prolactin in the cowbird's pituitary in relation to avian brood parasitism. *Nature*, **184**: 2030.—Cowbird pituitaries contain as much prolactin as those of Redwings. Failure of female cowbirds to form brood patches is therefore due to lack of response to the hormone.—H. C. S.
- JOWSKY, J. R., R. M. BLAKELY, and H. I. MACGREGOR. 1959. Effect of thiocic acid on gain in body-weight by turkey poult. *Nature*, **184**: 1323-1324.—Effect is negligible.
- MACFARLAND, L. Z. 1959. Captive marine birds possessing a functional lateral nasal gland (salt gland). *Nature*, **184**: 2030-2031.—All the albatrosses, boobies, penguins, and a frigatebird, cormorant, flamingo, and gull that were tested possessed a functional salt gland.—H. C. S.
- MAINARDI, D. 1959. Immunological distances among some gallinaceous birds. *Nature*, **184**: 913-914.—*Phasianus*, *Numida*, and *Meleagris* have close affinity

- while *Gallus* and *Coturnix* are remote from one another and from all other species.—H. C. S.
- MARSHALL, A. J. and D. L. SERVENTY. 1959. Experimental demonstration of an internal rhythm of reproduction in a transequatorial migrant (the Short-billed Shearwater *Puffinus tenuirostris*). *Nature*, **184**: 1704-1705.—Photostimulation has little or no effect.—H. C. S.
- MICHELSSEN, W. J. 1959. Procedure for studying olfactory discrimination in pigeons. *Science*, **130**: 630-631.—"A discrimination based on olfactory stimuli was established in two pigeons by an operant conditioning procedure. Results from control sessions demonstrate that the discrimination can be attributed only to the presence or absence of olfactory stimuli." (Author's abstract.)
- MILLER, A. H. 1959. Response to experimental light increments by Andean Sparrows from an equatorial area. *Condor*, **61**: 344-347.—Testes of six immature males enlarged in response to 16-hour photoperiods at an age when White- and Golden-crowned Sparrows are refractory.—R. E. P.
- MILLER, W. J. 1960. Sexual dichromatism in two species of the Columbidae. *Condor*, **62**: 45-48.—Injections of sex hormones alter plumage color of *Streptopelia tranquebarica* but not of *Columba livia*.—R. E. P.
- NAGRA, C. L. and I. O. BUSS. 1959. Change in body weight associated with onset of ovarian recrudescence and oviposition in pheasants. *Condor*, **61**: 348-350.—Body and ovary weights increase in spring.—R. E. P.
- PADGETT, C. A. and W. D. IVY. 1959. *Contornis* Quail as a laboratory research animal. *Science*, **129**: 267-268.—This species is recommended to embryologists and physiologists because of its hardiness, ease of handling, precociousness, and great laying ability.—J. C. H.
- SAWYER, W. H. 1960. Increased water permeability of the bullfrog (*Rana catesbeiana*) bladder *in vitro* in response to synthetic oxytocin and arginine vasotocin and to neurohypophyseal extracts from non-mammalian vertebrates. *Endocrin.*, **66**: 112-120.—Results show that avian (at least the chicken) neurohypophysis contains oxytocic properties and that the natural hormone may be arginine vasotocin.—H. C. S.
- SCHLUMBERGER, H. G. and H. J. RUDOLPH. 1959. Growth-promoting effect of a transplantable pituitary tumor in parakeets. *Endocrin.*, **65**: 902-908.—Evidence to indicate that the avian pituitary is capable of producing a growth hormone.—H. C. S.
- SELANDER, R. K. 1960. Failure of estrogen and prolactin treatment to induce brood patch formation in Brown-headed Cowbirds. *Condor*, **62**: 65.—Implants of three mg. pellets of estradiol in *Molothrus ater* and in a male canary. Brood patch formed in latter, but not in cowbirds even after daily additions of 50 IU Prolactin.—R. E. P.
- WOLFSON, A. and D. P. WINCHESTER. 1959. Effect of photoperiod on the gonadal cycle in an equatorial bird, *Quelea quelea*. *Nature*, **184**: 1658-1659.—Birds subjected to 8, 12½, and 16½ hour photoperiods showed gonadal recrudescence at a similar rate; those on eight hours regressed within two months, whereas others maintained their reproductive capacity.—H. C. S.

TAXONOMY AND PALAEONTOLOGY

- BLACKWELDER, R. E. "1959" [=1960]. The present status of systematic zoology. *Syst. Zool.*, **8**: 69-75.—Covers three chief topics: (1) a penetrating criticism

of the somewhat snobbish division of systematics into Old, or "morphological," and New, or "biological"; (2) a progress report on the Directory of Zoological Taxonomists (about 7,000 names; publication expected late in 1960); (3) a suggestion that much of the name changing that has given taxonomy a bad reputation is due to careless work and insufficient knowledge of earlier literature.—K. C. P.

CAIN, A. J. 1959. Taxonomic concepts. *Ibis*, **101**: 302-317.—An engrossing review of the evolution of avian taxonomic and related concepts from Ray and Willughby to the present, including cogent critical comments.—J. W. H.

GILLIARD, E. T. 1960. Results of the 1958-1959 Gilliard New Britain Expedition. I. A new genus of honeyeater (Aves). *Amer. Mus. Novitates*, **2001**: 5 pp.—*Vosea whitemanensis*, new genus and species, from Wild Dog Range, Whiteman Mts., New Britain, allied to *Melilestes*, *Melidectes*, and *Lichmera*. Eight specimens were obtained in original forests between 3,500 and 5,600 feet elevation.—K. C. P.

JOHNSGARD, P. A. 1960. Hybridization in the anatidae and its taxonomic implications. *Condor*, **62**: 25-33.—Diagrammatic summaries of recorded hybrids in the family by tribes with discussion of relationship indicated.—R. E. P.

MACDONALD, J. D. 1959. Old and new lines in taxonomy. *Ibis*, **101**: 330-334.—Using specific examples in living birds, the author discusses the employment of distributional variation, form and behavior, form and function in taxonomy, and the necessity of using all of these in achieving systematic goals.—J. W. H.

MAYR, E. 1959. Trends in avian systematics. *Ibis*, **101**: 293-302.—Current and past concepts of systematics and developments in this field are reviewed. "New Systematics," with the replacement of a monotypic by a polytypic species concept, a morphological by a biological species viewpoint, is now being supplemented by another advancement characterized by descriptions of population structures of species in terms of geographical isolates, population continuants, zones of secondary intergradation, and by renewed study of higher categories.—J. W. H.

MILLER, A. H. 1960. A blackish race of the Gray Seedeater of northern South America. *Condor*, **62**: 121-123.—*Sporophila intermedia anchicayae* from the valley of the Rio Anchicaya, Colombia.

MOREAU, R. E. 1959. The classification of the Musophagidae. *Systematics Assoc. Publ. no. 3*: 113-119.—Contains interesting discussion of the unique pigments of turacos, turacin (red) and turacoverdin (green).—E. E.

PARKES, K. C. 1960. Geographic variation in the Lesser Tree-swift. *Condor*, **62**: 3-6.—Study of *Hemiprocne comata* adds rectrices as character, retains two subspecies.—R. E. P.

SALOMONSEN, F. 1960. Notes on flowerpeckers (Aves, Dicaeidae). I. The genera *Melanocharis*, *Rhamphocaris*, and *Prionochilus*. *Amer. Mus. Novitates*, **1990**: 28 pp.—The sequence of genera proposed by Mayr and Amadon in 1947 is accepted, except that use of *Prionochilus*, 1841, rather than *Anaimos*, 1853, is resumed. Characters and distribution of species and subspecies admitted in the three most primitive genera are discussed. The two New Guinea genera *Melanocharis* and *Rhamphocaris* share a character unusual in passerines in that females are decidedly larger than males. In a list of examined type specimens, the author designates lectotypes for *Prionochilus plateni* Blasius and *P. johannae* Sharpe.—K. C. P.

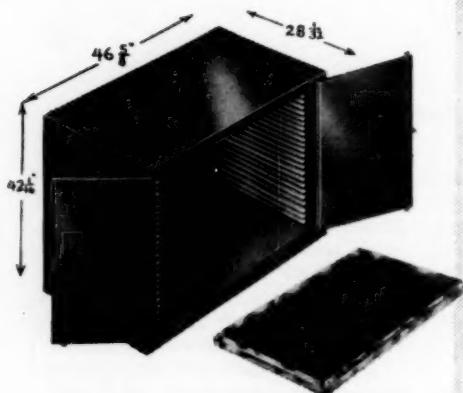
- SALOMONSEN, F. 1960. Notes on flowerpeckers (Aves, Dicaeidae). 2. The primitive species of the genus *Dicaeum*. Amer. Mus. Novitates, 1991: 38 pp.—Discusses 15 of the 35 species of *Dicaeum* admitted. The forms currently lumped into *D. agile* are divided among three species, *agile*, *everetti*, and *aeruginosum*; distribution of this group and of *D. trigonostigma* subsp. are mapped. One new name is introduced, *Dicaeum aureolimbatus laterale*, to replace *Priochilus sanghirensis* Salvadori, preoccupied when the species is transferred to *Dicaeum*.—K. C. P.
- TORDORF, H. B. 1959. A condor from the upper Pliocene of Kansas. Condor, 61: 338-343.
- VAURIE, C. 1960. Systematic notes on Palearctic birds. No. 39. Caprimulgidae: a new species of *Caprimulgus*. Amer. Mus. Novitates, 1985: 10 pp.—*C. centralasicus*, described from a single British Museum specimen from Goma, western Sinkiang, China. Resembles *C. aegyptius* (with which it had been confused) in pale coloration, but is thought to be more closely related to *C. nubicus* and *C. mahrattensis*. Relationships among Palearctic species of *Caprimulgus* are discussed. The reported occurrence of *C. aegyptius* in Chinese Turkestan is based on two specimens (one the type of *centralasicus*, one now lost), and requires confirmation.—K. C. P.
- VERHEYEN, R. 1959. Revision de la systématique des Falconiformes. Bull. Inst. Roy. Sci. Nat. Belg., 35, no. 37: 1-51.—The Falconiformes are divided into four suborders, Cathartae, Pandiones, Accipitres, and Falcones. The groups usually treated as subfamilies are elevated to families. Diagnoses are provided for the higher groupings down to tribes. A synoptic classification of the entire order down to the species level is supplied. Some of the conclusions are surprising and some not explained, notably the transfer of *Asturina* (of which Verheyen had no skeletal or anatomical material) from its usual place as a subgenus of *Buteo* (or an ally) to a subgenus of *Astur*, here considered to belong in a different tribe. Whatever one's opinion of the author's taxonomic conclusions, the vast amount of comparative data compiled and made available in this paper should prove useful to students of the birds of prey.—E. E.
- VERHEYEN, R. 1959. Les plongeons (Gaviae) et les grèbes (Podicipitides) dans les systèmes de classification. Bull. Inst. Roy. Sci. Nat. Belg., 35, no. 44: 1-12.—On the basis of 200 taxonomic characters, the loons and grebes are found not to be closely related. The loons are made a suborder of Verheyen's Alciformes, being said to be allied to the Alcidae, particularly *Uria*. The grebes are made a suborder of Ralliformes, allied to the Heliorhithidae.—E. E.

OBITUARY

CHARLES L. BROLEY of Delta, Ontario, an Elective Member of the American Ornithologists' Union, and a member since 1926, died suddenly in the early summer of 1959 as a result of fighting a brush fire near his home. He had shortly before returned from Tampa, Florida, where he had continued his long fight for protection and restoration of the Bald Eagle. He had just agreed to serve on the Wildlife Committee of the Florida Audubon Society, with special emphasis on his favorite bird. His presentation of the plight of America's National Bird at the Annual Meeting of the Society in March 1958 had inspired its officers to initiate a program of census and research leading to greater knowledge of the needs for survival of the Bald Eagle in Florida.

Mr. Broley was a banker by profession but retired at 58 to spend most of the following two decades in studying, banding, photographing, and lecturing about the Bald Eagle. He became adept in the use of rope ladders in climbing eagle trees and developed a national and international reputation as an authority on the species. Mrs. Broley, who preceded her husband in death by a year, wrote the "Eagle Man," which described his experiences with this great bird during his retirement years. The Broleys' daughter has deposited her father's records and eagle films with the Laboratory of Ornithology at Cornell University so that they may have further use. Many of us here in Florida, and throughout the country, considered Charlie Broley a fine personal friend, and the warmth of his association will be greatly missed as will his work in ornithology and conservation.—C. RUSSELL MASON, *Altamonte Springs, Florida*.

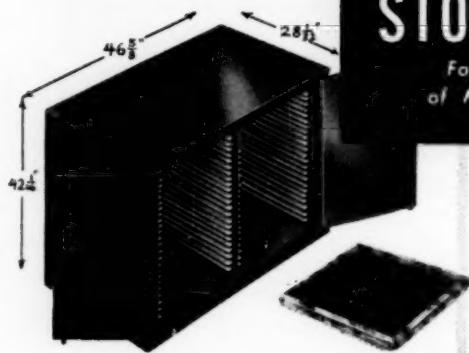




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